

The American Midland Naturalist

Founded by J. A. Nieuwland, C.S.C.

John D. Mizelle, *Editor*

CONTENTS

Bibliography of Biographies of Entomologists (Supplement).....	Mathilde M. Carpenter	257
An Ecological Study of a Minnesota Pond	Clarence F. Dineen	349
Summer Plankton of Lake Amatitlan, Guatemala.....	Richard S. Peckham and Clarence F. Dineen	377
Studies on the Formation and Function of Mucoids in Cercariae:		
Non-irrigulate Xiphidiocercariae	F. J. Kruidenier	382
A New Type of Metacercarial Cyst of the Genus Apophallus, from the Perch, <i>Perca flavescens</i> , in Minnesota	Bruce H. Warren	397
A Study of the Effects of Black and Yellow Grubs on <i>Lepomis cyanellus</i> and <i>L.</i> <i>humilis</i> in a Natural Environment	Thomas Ralph Rabideau and J. Teague Self	402
An Ecological Study of the Helminth Fauna of Macgillivray's Seaside Sparrow, <i>Ammospiza maritima macgillivrayi</i> (Audubon).....	Wanda Sanborn Hunter and Thomas L. Quay	407
On Regenerative Capacity of Earthworms of the Family Lumbricidae.....	G. E. Gates	414
Microdrili in Artificial Lakes in Northwest Arkansas	David Causey	420
Morphology and Developmental Stages of <i>Piona linguaplax</i> n. sp., (Hydracarina: Pionidae) a Water-mite from North Carolina	Robert M. Crowell	426
The Anatomy of the Feeding Apparatus of <i>Megisthanus floridanus</i> Banks, 1904, a Large Mesostigmatid Mite	Flora Gorirossi and G. W. Wharton	433
Notes on the Amphibians and Reptiles of Crater Lake National Park	Donald S. Farnier and James Kezer	448
Preliminary Notes on the Ecology of Freshwater Algae in the Arctic Slope, Alaska, with Descriptions of Some New Species	G. W. Prescott	463
The Production of Root Hairs by Aquatic Plants	Edfred Loren Shannon	474
Further Observations on Forest Invasion and Succession on Basins of Drained Lakes in Northern Minnesota.....	John B. Moyle and Etlar L. Nielsen	480
A Check-list of Ferns and Flowering Plants of the Quetico-Superior Wilderness Research Center	Olga Lakela	488
Notes on Wisconsin Parasitic Fungi. XIX	H. C. Greene	501
Notes and Discussion:		
New Southern Illinois Plant Records.....	Julius R. Swayne and Wm. M. Bailey	509
Notes on <i>Aquilegia</i>	Bernard Boivan	509
A New Form of <i>Gentiana Romanzovii</i>	Archibald W. Roach	510
Nembutal as a Relaxing Agent for Mollusks.....	Henry van der Schalie	511

EDITORIAL STAFF

JOHN D. MIZELLE	Zoology
Editor, University of Notre Dame, Notre Dame, Ind.	
EDWARD A. CHAPIN	Entomology
U. S. National Museum, Washington, D. C.	
ALBERT L. DELISLE	Plant Morphology
University of Notre Dame, Notre Dame, Ind.	
CARROLL LANE FENTON	Invertebrate Paleontology
404 Livingston Ave., New Brunswick, N. J.	
JOHN HOBART HOSKINS	Paleobotany
University of Cincinnati, Cincinnati, Ohio	
GEORGE NEVILLE JONES	Plant Taxonomy
University of Illinois, Urbana, Ill.	
REMINGTON KELLOGG	Mammalogy
U. S. National Museum, Washington, D. C.	
JEAN MYRON LINDSALE	Ornithology
Hastings Reservation, Robles del Rio, Calif.	
GEORGE WILLARD MARTIN	Mycology
State University of Iowa, Iowa City, Iowa	
HUGH M. RAUP	Plant Ecology
Harvard Forest, Harvard University, Petersham, Mass.	
KARL PATTERSON SCHMIDT	Ichthyology and Herpetology
Chicago Natural History Museum, Chicago, Ill.	

NOTE: THE AMERICAN MIDLAND NATURALIST, published by the University of Notre Dame is primarily, though not exclusively, devoted to the Natural History of the Middle West. A wide selection of papers on botany, paleontology and zoology is published quarterly. Each issue contains 256 pages, two of which comprise a volume.

Subscription rate per year \$6.00 in the U. S., Mexico and South American countries; \$7.00 elsewhere.

Authors are invited to submit carefully prepared manuscripts and requested to limit tables and illustrations as much as possible. Authors are requested to defray illustration costs beyond two full-page (4x6) plates.

The following numbers are out of print: Vol. 1 (1, 4, 5, 8-12); Vol. 2 (1-3, 8-9); Vols. 3, 4 (all numbers); Vol. 5 (1, 6-8); Vol. 6 (1, 5, 7-12); Vol. 7 (6); Vol. 8 (2); Vol. 9 (2); Vol. 12 (12); Vol. 14 (1, 5-6); Vol. 15 (4); Vol. 16 (2, 4); Vol. 17 (1); Vol. 18 (1); Vol. 21 (all numbers); Vol. 22 (1); Vol. 23 (all numbers); Vol. 24 (3); Vol. 25 (1, 2); Vol. 26 (2, 3); Vol. 27 (1); Vol. 36 (1); Vol. 37 (2, 3); Vol. 38 (1); Volume groups 1-12, 13-18, 19-49, and 50 contain 12, 6, 3 and 2 issues respectively. Available issues of Vols. 1-6, 50 cents; Vol. 7, 35 cents; Vols. 8-12, 50 cents; Vols. 13-14, 60 cents; Vol. 15, 75 cents; Vols. 16-18, \$1.00; Vols. 19-48, 50¢; \$4.00 a volume, single issues \$1.75. Vol. 49 Nos. 1, 3, \$1.75 each; Vol. 49 No. 2, \$4.00.

Inquiries concerning exchanges for specimens, journals, special volumes or duplicate books should be addressed to *The American Midland Naturalist*, Notre Dame, Indiana, where subscriptions are also received. Offers should accompany requests for exchange.

Abbreviated citation: *Amer. Midl. Nat.*

The *American Midland Naturalist* is indexed in the INTERNATIONAL INDEX.

Entered as second-class matter at Notre Dame, Indiana. Acceptance for mailing at special rate of postage provided for in section 1103; Act of October 3, 1917, authorized on July 3, 1918.



The American Midland Naturalist

Published Quarterly by The University of Notre Dame, Notre Dame, Indiana

VOL. 50

OCTOBER, 1953

No. 2

Bibliography of Biographies of Entomologists* (Supplement)

Mathilde M. Carpenter

Smithsonian Institution, Washington, D. C.

The present bibliography is both a continuation of and a supplement to my earlier one published in *The American Midland Naturalist*, 33(1):1-116, 1945, including additional references overlooked in the preparation of its predecessor.

It will be noted that the names of many individuals who did very little work in entomology are listed, but if even a single paper was published the name of the author has been included. Thus this bibliography supplies information supplementary to that in the *Index Litteraturae Entomologicae* by Horn and Schenkling, 1928-29.

Some reviewers have questioned the advisability of including in the earlier bibliography the names of collectors, but my experience as a librarian has shown that there is a considerable demand for this information, so the same procedure has been followed here.

This work at best is far from complete, and inevitably many names and references may have escaped my notice.

I wish to take this opportunity for thanking most cordially all who have shown such an interest in this supplement as to send additional data, as well as corrections of dates and names. I am especially indebted to Harry B. Weiss and Mortimer D. Leonard for their many helpful contributions.

Bibliography of Biographies of Entomologists (SUPPLEMENT)

Italicized letters *A.* = Anonymous, *B.* = Bibliography, *P.* = Portrait.

- AALBORG, Niels Mikkelsen (1562-1645). Henriksen, K. L., *Ent. Meddelelser* 15:25, 1921.
- AALL, Nicolai Benjamin (1805-1888). Natvig, L. R., *P., Norsk Ent. Tidskrift* 7:45-47, 1944.
- AARON, Samuel Francis (-1947). *A.*, *Ent. news* 58:49, 1947; Calvert, P. P., *Ent. News* 58:137-140, 1947; Weiss, H. B., *Ent. News* 58:235-236, 1947.
- ABBOT, John (1750-1840). Bassett, A. S., *Auk* 55:244-254, 1938; Allen, E. G., *Auk* 59:563-571, 1942; Chamberlin, R. V., et al., *P., Bull. Univ. Utah* 35 (9) (Biol. Ser. 8(5)):7-24, 1944; Scudder, S. H., *Canadian Ent.* 20:150-154, 1888; Kirby, W. F., *Ann. Rpt. Ent. Soc. Ont.* 19:50-51, 1888; Remington, C. L., *P., Lepidop.*

* Published with permission of the Secretary of the Smithsonian Institution.

- terists' News 2:28-30, 1948.
- ABBOT, Walter Sidney (1879-1943). Osborn, H., *Fragments Ent. Hist.* 2:57, 1946.
- ABEL, Ludwig (-1940). A., *Ztschr. Wien. Ent. Ver.* 26:32, 1941.
- ABILDGAARD, Peter Christian (1740-1801). Henriksen, K. L., P., *Ent. Meddelelser* 15:103-105, 1923.
- ABRAHAM, Rudolf (1905-1942). Sachtleben, H., *Arb. Phys. Angew. Ent.* 9:55, 1942.
- ABT, Veli Kurt (1892-1920). A., *Notulae Ent.* 1:26, 1921.
- ACERBI, Giuseppe (1773-1846). Rose, H. J., *New Gen. Biog. Dict.* 1:71, 1850.
- ACHARIUS, Eric (1757-1819). Rose, H. J., *New Gen. Biog. Dict.* 1:72-73, 1850.
- ACKERMAN, Arthur John (1889-1937). Osborn, H., *Fragments Ent. Hist.* 2:57, 1946.
- ACOSTA, José d' (1539-1600). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:76-77, 1919; Hagen, V. W. von, *Green World of the Naturalists* pp. 56-75, 1948.
- ACQUA, Camillo (1863-1936). Lombardi, L., B., P., *Riv. Biol. (Firenze)* 21:150-158, 1936; Lombardi, L., *Boll. Staz. Sper. Gelsic. Bachic Ascoli Piceno* 15:iii-v, 1936.
- ADAMS, Charles Frederick (1877-1950). A., P., *Jefferson City, Mo. Sunday News & Tribune*, Jan. 22, p. 1, 1950; Cattell, J., *Amer. Men of Sci.* p. 8, 1949.
- ADAMS, Herbert Jordan (1838-1912). A., *Ent. Mo. Mag.* 48:243, 1912; Morice, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:clxiv, 1912.
- ADAMSON, Alastair Martin (1901-1945). A., P., *Trop. Agriculture (Trinidad)* 23:3-4, 1946.
- ADAMSON, Michel (1727-1806). Cuvier, G., *Eloges Historiques* pp. 131-161, 1835; Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* p. 54, 1836; Rose, H. J., *New Gen. Biog. Dict.* 1:97-98, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:87, 1865-76.
- ADDIS, Clarence John, Jr. (1921-1946). Chandler, A. C., P., *Journ. of Parasitol.* 32:585-586, 1946.
- ADENSAMER, Theodor (1867-1900). A., *Verh. Zool.-Bot. Ges. Wien* 50:579, 1900.
- ADKIN, Benaiah Whitley (1865-1948). "C. G. M. de W.," *Entomologist* 82:22, 1949.
- ADRIAANSE, Aloys (1908(?) -1946). Wilcke, J., *Ent. Berichten* 12:33, 1946.
- ADYE, James Mortimer (1860(?) -1895). A., *Ent. Mo. Mag.* 31:122, 1895; Meldola, R., *Trans. Ent. Soc. Lond. (Proc.)*:lxx-lxxi, 1895.
- ÆLIANUS, Claudius (-). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* p. 12, 1836; Rose, H. J., *New Gen. Biog. Dict.* 1:123-124, 1850.
- AGASSIZ, Alexandre (1835-1910). Gardiner, J. S., *Proc. Linn. Soc. Lond.* pp. 83-86, 1910; Machon, F., *Bull. Soc. Vaudoise Sci. Nat.* 46 (*Procès-Verbeaux*):xxxix-xl, 1910.
- AGASSIZ, Jean Louis Rodolphe (1807-1873). A., *Nat. Canadien* 6:22-24, 1874; A., *Globus* 25:126-127, 1874; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 1-4, 1874; Porchet, F., et al., P., *Bull. Soc. Vaudoise Sci. Nat.* 43:301-386, 1907; Jaffe, B., *Men of Science in Amer. Soc.* 233-257, 1944.
- AGRICOLA, GEORG (1494-1555). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* p. 16, 1836; Rose, H. J., *New Gen. Biog. Dict.* 1:160, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:141, 1865-76.
- AHLWARDT, Karl (1873-1915). Schumacher, F., P., *Deutsche Ent. Ztschr.* pp. 222-224, 1915.
- AICHHORN, Sigmund Johann Nepomuk (1814-1892). Rumpf, J., P., *Mitt. Naturw. Ver. Steiermark* 29:246-261, 1892.
- AIGNER-ABAFI, Ludwig von (1840-1909). "A. H. J.," *Ent. Record* 21:244, 1909; A., P., *Ent. Rundschau* 26:86, 1909.
- AINSLIE, Charles Nicholas (1856-1939). Sachtleben, H., *Arb. phys. angew. Ent. Berlin-Dahlem* 7:169, 1940; Osborn, H., P., *Fragments of Ent. Hist.* 2:57-58, 1946.
- ALAMANNI, Luigi (1495-1556). Rose, H. J., *New Gen. Biog. Dict.* 1:201-202, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:171, 1865-76.
- ALBERS, Gustave (-1893). Barthe, E., *Miscellanea Ent.* 2:107, 1894.
- ALBERTIS, Luigi Maria d' (1841-1901). Ross, E., *Internat. Ent. Ztschr.* 27:388, 1933.
- ALBERTUS, Magnus (1193-1280). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* p. 14, 1836; Rose, H. J., *New Gen. Biog. Dict.* 1:233-234, 1850; Henriksen, K. L., *Ent. Meddelelser* 15:8-9, 1921; Brockhaus, F. A., P.,

- Der Grosse Brockhaus 1:243, 1928.
- ALBIN, Eleazar (1713(?) - 1759(?)). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* p. 30, 1836.
- ALBINUS, Bernhard Sigfrid (1697-1770). Rose, H. J., *New Gen. Biog. Dict.* 1:237, 1850.
- ALBRECHT, Johann (1695-1774). Rose, H. J., *New Gen. Biog. Dict.* 1:240, 1850.
- ALCOCK, Alfred William (1859-1933). A., *Nature* 131:573-575, 1933; "B. P.," P., *Journ. Bombay N. H. Soc.* 36:726-728, 1933; Manson-Bahr, P., P., *Trans. Roy. Soc. Trop. Med. & Hyg.* 27:213-215, 1933.
- ALDRICH, John Merton (1866-1934). Porter, C. E., B., P., *Rev. Chilena Hist. Nat.* 38:76-77, 1934; Hatch, M. H., P., *Century of Entomology in Pacific Northwest* p. 10, 1949.
- ALDROVANDI (ALDROVANDUS), Ulysse (1522-1605). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* pp. 18-19, 1836; Jardine, W., P., *Naturalist's Library* 17:17-58, 1848; Rose, H. J., *New Gen. Biog. Dict.* 1:257-258, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:187, 1865-76; Henriksen, K. L., *Ent. Meddelelser* 15:12-13, 1921.
- ALEXANDRE, Auguste (1811-1886). Bourgeois, J., *Ann. Soc. Ent. France* (6) 6 (Bull.) :xcvii, 1886.
- ALLAN, William (1820-1915). Hamilton, A. G., *Proc. Linn. Soc. N. S. Wales* 41:5, 1916.
- ALLARD, Ernest (-1900). Giard, A., *Bull. Soc. Ent. France* p. 42, 1900.
- ALLARD, Gaston (1838(?) - 1918). Edwards, S., *Proc. So. Lond. Ent. & N. H. Soc.* p. 37, 1918-19; Desbordes, H., et al., *Bull. Soc. Ent. France* p. 50, 1918.
- ALLEN, James Edward Rothwell (1866-1916). Burrows, C. R. N., *Ent. Record* 29:67-68, 1917.
- ALLÉON-DULAC, Jean Louis (-1768). Rose, H. J., *New Gen. Biog. Dict.* 1:348, 1850.
- ALLIONI, Carlo (1725-1805). Rose, H. J., *New Gen. Biog. Dict.* 1:352, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:221, 1865-76.
- ALPINI (ALPINUS) Prospero (1553-1617). Rose, H. J., *New Gen. Biog. Dict.* 1:361-362, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:236, 1865-76.
- ALSTED (ALSTEDIUS) Johann Heinrich (1588-1638). Rose, H. J., *New Gen. Biog. Dict.* 1:364, 1850.
- ALTUM, Bernard (1827-1900). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftstellen-Lexikon* pp. 9-11, 1874.
- AMATUS LUSITANUS (João Rodriguez de Castello Branco) (1511-1568). Rose, H. J., *New Gen. Biog. Dict.* 1:379, 1850.
- AMES, Sarah (-1902). A., *Ent. Record* 14:139, 1902.
- AMMANN, Josef (1873-1940). Heikertinger, F., *Koleopt. Rundschau* 26:92, 1940; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 8:77, 1941; A., *Ent. Blätter* 36:157, 1940.
- AMMITZBOLL, Ivar Frederick Christian (1847-1934). Engelhart, C., P., *Ent. Meddelelser* 12:15, 1918.
- AMORETTI, Carlo (1741-1816). Rose, H. J., *New Gen. Biog. Dict.* 1:405, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:283, 1865-76.
- AMOREUX, Pierre Joseph (1741-1824). Rose, H. J., *New Gen. Biog. Dict.* 1:405, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:283, 1865-76.
- ANDERSON, James (1739-1808). Rose, H. J., *New Gen. Biog. Dict.* 1:430-431, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:334, 1865-76.
- ANDERSON, John (1873(?) - 1939). A., P., *Amer. Bee Journ.* 79:340, 1939.
- ANDERSSON, Carl Johan (1827-1867). MacGillivray, D., B., *Ent. Berichten* 12:173-175, 1947.
- ANDERSSON, Snickare Eric (1890(?) - 1939). A., P., *Bitidningen* 2(2):42, 1940.
- ANDRADE, Edmundo Navarro de (See under NAVARRO).
- ANDRÉ, Albert Argod-Vallon (1859-1936). A., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 4:160, 1937.
- ANDRÉ, Jacques Ernest Edmond (1844-1891). "F.," *Krancher's Ent. Jahrbuch* p. 197, 1892.
- ANDREAS, Karl (1867(?) - 1932). Gaul, W., *Ent. Ztschr. (Frankfurt)* 46:133, 1932.

- ANDREINI, Alfredo (1870-1943). DeBeaux, O., Ann. Mus. Civ. Stor. Nat. (Genova) 62:(1)-(2), 1945.
- ANDRES, Adolf (-1931). "G. O.," Ent. Ztschr. (Frankfurt) 45:170-171, 1931.
- ANDREWS, Frederick (1859-1932). "E. B. P.," P., Obit. Notices Fellows Roy. Soc. (Lond.) 1:37-44, 1932.
- ANDREWS, H. L. (-1946). Williams, C. B., Proc. Roy. Ent. Soc. Lond. (C) 13:66, 1948-49.
- ANGELL, John Watson (1885-1946). Bromley, S. W., Journ. N. Y. Ent. Soc. 54:290, 1946.
- ANGLEMAN, John Barton (1860-1926). Engelhardt, G. P., Bull. Bklyn. Ent. Soc. 21:181, 1926.
- ANKER, Ludwig (1822-1887). Aigner, L., P., Rovartani Lapok (Budapest) 8:197-203, German summary 8(10):23, 1901.
- ANKER, Rudolf (1824-1901). Aigner, L., Rovartani Lapok (Budapest) 8:197-203, German summary 8(10):23, 1901.
- ANNAND, Percy Nicol (1898-1950). A., P., Evening Star, Washington, D. C., Mar. 30, Sect. A, p. 26, 1950; A., P., Washington Post, Mar. 30, Sect. B, p. 2, 1950; A., Washington Daily News, Mar. 30, p. 53, 1950; Who's Who in America 25:73, 1948-49; Cattell, J., Amer. Men of Science 8th ed., p. 60, 1949.
- ANNANDALE, Thomas Nelson (1876-1924). "S. K.," et al., B., P., Rec. Indian Mus. 27:1-28, 1925.
- ANNONE, Jean Jacques d' (1728-1804). Rose, H. J., New Gen. Biog. Dict., 1:483, 1850.
- ANTIGA Y SUNYER, Pedro (1854-1904). Morice, F. D., Ent. Mo. Mag. 40:239, 1904; Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:174-175, 1919.
- APFELBECK, Viktor (1859-1934). Apfelbeck, V., B. only (1889-1922), Glasnik Zem. Bosn. Hercegovini 35:31-47, 1923.
- APHELEN, Hans von (1719-1779). Henriksen, K. L., Ent. Meddelelser 15:26, 1921.
- APICIUS (APITIUS), Caelius (-). Rose, H. J., New Gen. Biog. Dict. 2:42, 1853; Larousse, P., Grand Dict. Univ. du xix Siècle 1:476, 1865-76.
- ARCAS, Laureano Perez (See under PEREZ ARCAS).
- ARCAYA, Manuel Díaz de (1841-1916). Lopez de Zuazo, J. L., P., Bol. Soc. Aragon. Cienc. Nat. 16:96-113, 1917.
- ARCHER, Francis (1839-1892). A., Ent. Record 3:80, 1892; Capper, S. J., Ent. Mo. Mag. 28:112, 1892; Reade, T. M., P., Naturalist (Lond.) pp. 113-116, 1892; A., Entomologist 25:100, 1892.
- ARECHAVELETA, Joseph (-1912). A., Deutsche Ent. Ztschr. p. 608, 1912.
- ARGOD, Albert (1859(?) -1936). Barthe, E., Miscellanea Ent. 37:123-124, 1936.
- ARISTOTLE (384 B. C.-322 B. C.). Eiselt, J. N., Geschichte, Systematik und Literatur der Insectenkunde pp. 3-10, 1836; Jardine, W., P., Naturalist's Library 14:17-112, 1848; Rose, H. J., New Gen. Biog. Dict. 2:142-153, 1853; Larousse, P., Grand Dict. Univ. du xix Siècle 1:631-632, 1865-76; Schenckling, S., Illustr. Wochenschrift f. Ent. 1:469-473, 491-493, 1896; Burckhardt, R., Zoologische Annalen 3:69-77, 1910; Brockhaus, F. A., Der Grosse Brockhaus 1:666-667, 1928; Pellett, K. L., Amer. Bee Journ. 69:346-347, 1929; Lizer y Trelles, C. A., Curso de Entomologia (Arg.) 1:5-7, 1947; Conrad, A., Sitz-Ber. Ges. Naturf. Freunde Berlin pp. 147-152, 1940.
- ARMITAGE, Edward (1817-1896). A., Ent. Mo. Mag. 32:164, 1896.
- ARNOLD, Eugen (1866-1939). Kell, F. S., Mitt. Muench. Ent. Ges. 30:437-439, 1940; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 7:170, 1940.
- ARNOLD, Walter (1892-1938). Heikertinger, F., Koleopt. Rundschau 25:78, 1939.
- ARO, Johan Emil (1874-1928). Forsius, R., Notulae Ent. (Finland) 8:63-64, 1928.
- ARPE, Toimi Auvo Akseli (1917-1941). Kangas, Y., Ann. Ent. Fennici 10:156, 1944.
- ARROW, Gilbert John (1873-1948). Blair, K. G., Ent. Mo. Mag. 84:264, 1948.
- ASHBY, Edwin (1861-1941). Winckworth, R., Proc. Linn. Soc. Lond. 153:287-288, 1940-41.
- ASHBY, Sidney Robert (1864-1944). Jarvis, C. M., P., Proc. & Trans. So. Lond. Ent. & N. H. Soc. pp. xxv-xxvii, 1944-45; Jarvis, C. M., Ent. Mo. Mag. 80:264, 1944.
- ASHMEAD, William Harris (1855-1908). Essig, E. O., B., P., Hist. Applied Ent. pp. 539-541, 1932; A., P., Ent. Rundschau 26:3, 1909.

- ATKINSON, William Stephen (-1876). Westwood, J. O., *Trans. Ent. Soc. Lond. (Proc.)*:xliv, 1876.
- ATZE, Christian Gotlieb (-1826). Rose, H. J., *New Gen. Biog. Dict.* 2:313, 1853.
- AUBÉ, Charles (1802-1869). Marseul, S. A. de, *B. only*, *L'Abeille*, 20 (Les Entom. et leurs Écrits):1-5, 1882.
- AUBRIET, Claude (1651-1743). Rose, H. J., *New Gen. Biog. Dict.* 2:320-321, 1853; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:917, 1865-76.
- AUDÉOUD, Georges (1874-1943). "J. R.," *B. P.*, *Mitt. Schweiz. Ent. Ges.* 19:209-216, 1945; Olivier, J., *B. P.*, *Verh. Schweiz. Naturf. Ges.* 123:293-295, 1943.
- AUDOUIN, Jean Victor (1797-1841). Bouvier, L. E., *P.*, *Ann. Sci. Nat. (Zool.)*:17:1-3, 1934; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 18-19, 1874.
- AUMONT, Louise Caroline d' (1827-1853). Mulsant, E., *P.*, *Opuscles Entomologiques* 6:184-196, 1855; Mulsant, E., *Ann. Soc. Linn. Lyon*, n. s. 2:284-296, 1855.
- AUSSERER, Anton (1843-1889). Bonnet, P., *P.*, *Bibliographia Araneorum* 1:47-48, 1945.
- AUSTEN, Ernest Edward (1867-1938). Roubaud, E., *Bull. Soc. Path. Exot.* 31:178, 1938; Smart, J., *B.*, *Journ. Soc. Bibl. Nat. Hist.* 2:43-49, 1945; Riley, N. D. et al., *Nature* 141:358-359, 1938.
- AVEBURY, Lord. (See under LUBBOCK, John William.)
- AVERILL, Alice W. (-1946). Patch, E. M., *Journ. Econ. Ent.* 39:825, 1946.
- AVINOFF, Andrey (1884-1949). *A.*, *Ent. News* 60:154, 1949; Hellman, G. T., *New Yorker Mag.*, Aug. 21, pp. 32-44, 1948; Cattell, J., *Amer. Men of Science* p. 61, 1944.
- AYYAR, P. N. Krishna (See under KRISHNA AYYAR).
- AZARA, Felix d' (1746(?) -1821). Rose, H. J., *New Gen. Biog. Dict.* 2:416, 1853; Larousse, P., *Grand Dict. Univ. du xix Siècle* 1:1106, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 2:167, 1929; Hagen, V. W. von, *Green World of the Naturalists* pp. 131-144, 1948; Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:82, 1919.
- AZEVEDO, MARQUES, Luis Augusto (See under MARQUES).
- BABINGTON, Charles Cardale (1808-1895). Meldola, R., *Trans. Ent. Soc. Lond. (Proc.)*:lxix-lxx, 1895.
- BACCHUS, Arthur Douglas (-1924). *A.*, *Ent. Mo. Mag.* 60:157-158, 1924.
- BACHINGER, I. (1856-1939). Heikertinger, F., *Koleopt. Rundschau* 25:206, 1939.
- BACHMETZEW, Porfirig Ivanovich (1860-1913). *A.*, *Ent. Zeitschrift (Frankfurt)* 27:222, 1913; Kuhn, P., *Deutsche Ent. Ztschr.* p. 92, 1914.
- BACKHAUS, Ernst (-1912). Ross, E., *Internat. Ent. Ztschr.* 27:388, 1933.
- BAER, Carl Ernst von (1792-1876). Oppenheimer, J. M., *P.*, *Quart. Review of Biol.* 15:2-4, 1940; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 21-28, 1874.
- BAIER, Johann Jacob (1677-1735). Rose, H. J., *New Gen. Biog. Dict.* 3:2-3, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:55, 1865-76.
- BAIKIE, William Balfour (1825-1864). Pascoe, F. P., *Trans. Ent. Soc. Lond. (3)* 2 (*Journ. of Proc.*):71, 1864-66.
- BAILEY, James Harold (1870-1909). Tomlin, J. R. le B., *Ent. Mo. Mag.* 45:260-261, 1909; Horn, W., *Deutsche Ent. Ztschr.* p. 112, 1909; *A.*, *Ent. Rundschau* 27:10, 1910.
- BAIRSTOW, Samuel Denton (-1899). Bouvier, E. L., *Bull. Soc. Ent. France* p. 285, 1899.
- BAKER, Charles Fuller (1872-1927). Hernandez, B., *B. only*, *Lingnan Sci. Journ.* 5:271-279, 1927; Essig, E. O., *Hist. of Ent.* pp. 542-548, 1931.
- BAKER, Henry (1698-1774). Rose, H. J., *New Gen. Biog. Dict.* 3:29-30, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:76, 1865-76.
- BALASSOGLO, Vladimir Alexandrovich (1841-1900). Jacobson, G., *Horae Soc. Ent. Ross.* 35:li-lyi, 1901.
- BALBIANI, Edouard Gérard (1823-1899). Giard, A., *Bull. Soc. Ent. France* pp. 265-266, 1899; Henneguy, L. F., *B. P.*, *Arch. d'Anat. Micro.* 3:i-xxvi, 1899-1900.
- BALBIN (BALBINUS), Bohuslaus Aloysius (1621-1688). Rose, H. J., *New Gen. Biog. Dict.* 3:39-40, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:95, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 2: 240, 1929.

- BALDINGER, Ernst Gottfried (1738-1804). Rose, H. J., New Gen. Biog. Dict. 3:48-49, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:98, 1865-76.
- BALFOUR, Alice B. (-1936). Imms, A. D., Proc. Roy. Ent. Soc. Lond. (C) 1:54-55, 1936-37.
- BALFOUR, Andrew (1873-1931). A., P., Journ. Trop. Med. & Hyg. 34:63-64, 1931; A., Journ. Parasitol. 17:166, 1931; "P. H. M.-B.," British Med. Journ. 1:245-246, 1931; A., P., Lancet, 220:325-327, 1931; "C. M. W.," et al., P., Trans. Roy. Soc. Trop. Med. & Hyg. 24:655-660, 1931; A., Med. Journ. & Record 133:510, 1931.
- BALL, Elmer Darwin (1870-1943). Drake, C. J., B., P., Proc. Iowa Acad. Sci. 51:97-106, 1944; Vorhies, C. T., Journ. Wash. Acad. Sci. 34:205-206, 1944; Watson, J. R., Florida Ent. 26:60-61, 1943; Osborn, H., Fragments Ent. Hist. 2:58-60, 1946.
- BALLENSTEDT, Johann Georg Justus (1756-1840). Rose, H. J., New Gen. Biog. Dict. 3:84, 1850.
- BALLOU, Henry Arthur (-1937). A., Mass. State Coll. Fernald Club Yearbook 7:26, 1938.
- BALY, Joseph Sugar (1816-1890). Walsingham, Lord. Trans. Ent. Soc. Lond. (Proc.):lviii, 1890.
- BANCROFT, Edward (1744-1821). Rose, H. J., New Gen. Biog. Dict. 3:105-106, 1853; Larousse, P., Grand Dict. Univ. du xix Siècle 2:146, 1865-76.
- BANCROFT, Thomas Lane (-1933). A., P., Med. Journ. of Australia 1:512-514, 1934; Cilento, R. W., Proc. Roy. Soc. Queensland 46:1, 1934; Hines, H. G. J., Proc. Roy. Soc. Queensland 57:75-78, 1947; Taylor, F. H., P., Proc. Linn. Soc. N. S. Wales 68(1-2):v-vii, 1943.
- BANDO, Wilhelm (1819-). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 28-30, 1874.
- BANG-HAAS, Andreas (1846-1925). Heller, K. M., B., Deutsche Ent. Ztschr. Iris 39:1-4, 1925; Meissner, O., P., Ent. Ztschr. (Frankfurt) 42:227-228, 1928; Henriksen, K. L., B., P., Ent. Meddelelser 15:403-404, 1936; Engelhart, C., P., Ent. Meddelelser 12:15-16, 1918.
- BANG-HAAS, Otto (1882-1948). Riley, N. D., Entomologist 82:22, 1949; Holik, O., B., Ent. Zeitschrift 59:49-51, 1949.
- BANISTER, John (-1689(?)). Rose, H. J., New Gen. Biog. Dict. 3:114-115, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:154, 1865-76.
- BANKS, Joseph (1743-1820). Rose, H. J., New Gen. Biog. Dict. 3:118-121, 1850; Jarvis, C. M., P., Proc. & Trans. So. Lond. Ent. & N. H. Soc. pp. 60-68, 1943-44.
- BANTI, Adolfo (-1934). A., Boll. Soc. Ent. Ital. 66:182, 1934.
- BARBARUS, Hermolaus II (BARBARO, Ermolgo) (1454-1495). Eiselt, J. N., Geschichte, Systematik und Literatur der Insektenkunde p. 14, 1836; Rose, H. J., New Gen. Biog. Dict. 3:137, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:206, 1856-76.
- BARBER, George Ware (1890-1948). Wade, J. S., P., Journ. Econ. Ent. 42:163-165, 1949; Packard, C. M., Univ. of Mass. Fernald Club Yearbook 18:36-37, 1949.
- BARBOUR, Thomas (-1946). Gardiner, J. S., Nature 157:220, 1946.
- BARCLAY, Richard D. (-1938). A. P., Amer. Bee Journ. 79:36-37, 1939.
- BARFOED, Erik Christian (1847-1937). Henriksen, K. L., Ent. Meddelelser 15:543, 1937.
- BARICELLI (BARICELLO), Giulio Cesare (-1800(?)). Rose, H. J., New Gen. Biog. Dict. 3:176, 1850.
- BARKER, Henry William (-1909). Dixey, F. A., Trans. Ent. Soc. Lond. (Proc.):lxxxviii, 1909; Hall, T. W., Entomologist 42:288, 1909.
- BARLOW, John (1872-1944). Weiss, H. B., Ann. Ent. Soc. Amer. 39:3-4, 1946.
- BARNARD, Francis George Allman (1857-1932). "E. E. P.," B., P., Victorian Nat. 49:69-73, 1932.
- BARNARD, William Stebbins (1849-1887). Herriott, F. I., B., P., Annals of Iowa (3) 20:323-329, 1936.
- BARNES, William (1860-1930). Van Duzee, E. P., Pan-Pacific Ent. 7:16, 1930; A., Ann. Carnegie Mus. 19:223-224, 1930.

- BARNES, Thomas Alexander (-1930). Talbot, G., *Entomologist* 63:119-120, 1930.
- BARON, Oscar Theodor (1847-1926). Meissner, O., *Ent. Ztschr. (Frankfurt)* 43:131, 1929.
- BARRAUD, Philip James (1879-). Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (C)* 13:66, 1948-49.
- BARRÈRE, Pierre (1690(?)-1755). Rose, H. J., *New Gen. Biog. Dict.* 3:224, 1850; Larousse, P., *B., Grand Dict. Univ. du xix Siècle* 2:261, 1865-76.
- BARRETT, Charles Golding (1836-1904). A., *Insekten-Börse* 22:14, 1905; Poulton, E. B., *Poulton, Trans. Ent. Soc. Lond. (Proc.):xcviii-c*, 1904; A., *Ent. Record* 17:26, 1905.
- BARRETT, J. Platt (1838-1916). Porritt, G. T., *Ent. Mo. Mag.* 53:69-70, 1907.
- BARRINGTON, Daines (1727-1800). Rose, H. J., *New Gen. Biog. Dict.* 3:232, 1850; Larousse, P., *B., Grand Dict. Univ. du xix Siècle* 2:267, 1865-76.
- BARROWS, Walter Bradford (1855-1923). Fisher, A. K., *B., P., Auk* 42:1-14, 1925.
- BARTELS, Carl (-1901). A., *Insekten-Börse* 18:378, 1901.
- BARTHE, Eugène (1862-1945). Basilewsky, et al., *Miscellanea Ent.* 42:1, 1945; Favarel, G., *P., Miscellanea Ent.* 44:113-118, 1947; Licent, R. P., *Bull. Soc. Ent. France* 50:69, 1945.
- BARTHELEMY, Jean Jacques (1716-1795). Rose, H. J., *New Gen. Biog. Dict.* 3:254-256, 1850; Brockhaus, F. A., *Der Grosse Brockhaus* 2:336, 1929; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:276, 1865-76.
- BARTHOLIN (BARTHOLINUS), Thomas (1616-1680). Rose, H. J., *New Gen. Biog. Dict.* 3:261-262, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:284, 1865-76; Henriksen, K. L., *Ent. Meddelelser* 15:15, 22, 23, 533, 1921-37.
- BARTHOLOMAEUS, Anglicus (-). Rose, H. J., *New Gen. Biog. Dict.* 3:264-265, 1850; Brockhaus, F. A., *Der Grosse Brockhaus* 2:337, 1929.
- BARTOLOZZI, Francesco (1730-1813). Rose, H. J., *New Gen. Biog. Dict.* 3:274-276, 1850; Larousse, P., *B., Grand Dict. Univ. du xix Siècle* 2:286, 1865-76.
- BARTON, Benjamin Smith (1766-1815). Rose, H. J., *New Gen. Biog. Dict.* 3:279-281, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:287, 1865-76.
- BARTON, Stephen (-1898). Hudd, A. E., *Ent. Mo. Mag.* 35:16, 1899; Trimen, R., *Trans. Ent. Soc. Lond. (Proc.):liv*, 1898.
- BARTRAM, John (1699-1777). Rose, H. J., *New Gen. Biog. Dict.* 3:283-284, 1850; Harper, F., *P., Trans. Amer. Philos. Soc.* 33:1-120, 1942; Hume, H. H., *Florida Hist. Quart.* 21:293-294, 1943; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:287, 1865-76; Elder, L. W., *Bios* 5:45-46, 1934; Swen, E. G., *Proc. Amer. Antiq. Soc.* 58:111-115, 144-150, 1948.
- BARTRAM, William (1739-1823). Rose, H. J., *New Gen. Biog. Dict.* 3:284, 1850; Harper, F., *P., Trans. Amer. Philos. Soc.* 33:121-242, 1943; Hume, H. H., *Florida Hist. Quart.* 21:294-295, 1943; Elder, L. W., *Bios* 5:45-46, 1934.
- BARTSCHT, Ambros (-1904). A., *Wien. Ent. Zeit.* 23:150, 1904.
- BATES, Frederick (1829-1903). Poulton, E. B., *Trans. Ent. Soc. Lond. (Proc.):lxxiv-lxxv*, 1903.
- BATES, George Latimer (1863-1940). Kinear, N. B., et al., *Ibis* (14) 4:343-348, 1940.
- BATES, Henry Walter (1823-1892). Sharp, D., *Entomologist* 25:77-80, 1892; "A. R. W.," *Nature* 45:398-399, 1892; Lefèvre, E., *Ann. Soc. Ent. France* 61 (Bull.):xlii, 1892; A., *Insekten-Börse*, 9 (8):unpagued, 1892; Boucard, A., *P., The Hummingbird* 2:24-31, 1892; Olsoufieff, G. de, *P., Insecta* 13:203-205, 1924; Hagen, V. W. von, *Green World of the Naturalists* pp. 223-244, 1948; Alston, A. H. G., *P., Geog. Journ. (Lond.)* 112:1-3, 1949.
- BATESON, William (1861-1926). "J. B. F.," *P., Proc. Roy. Soc. Lond. (B)*, 101:i-v, 1927.
- BATH, Wolfgang (1882-1932). Freise, I. A., *Insekten-Börse* 49:153, 1932.
- BATTLE, Arthur Unwin (-1905). A., *Insekten-Börse* 22:78, 1905; A., *Entomologist* 38:144, 1905.
- BATTY, James (1831-1893). A., *Ent. Record* 4:297, 1893; Elwes, H. J., *Trans. Ent. Soc. Lond. (Proc.):lvii*, 1893.
- BAU, Arminius (1861-1932). Alfken, J. D., *B., P., Konowia* 11:147-150, 1932.
- BAUER, Heinrich (-1915). Hubenthal, W., *Ent. Blätter* 12:138, 1916.

- BAUHIN, Jean (1541-1613). Rose, H. J., *New Gen. Biog. Dict.* 3:375-376, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:391, 1865-76.
- BAUM, Jiri (1900-1943). Novák, V., B., P., *Acta Soc. Zool. Cechosl.* 10:35-38, 1945-46.
- BAUMÉ, Antoine (1728-1804). Rose, H. J., *New Gen. Biog. Dict.* 3:378-379, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:394, 1865-76.
- BAUMEISTER, Johannes (-1891). A., P., *Insekten-Börse* 8(18):unpaged, 1891.
- BAUMER, Johannes Paulus (1725-1771). Rose, H. J., *New Gen. Biog. Dict.* 3:379, 1850.
- BAUMHOFER, Lynn G. (1895-1942). Osborn, H., *Fragments Ent. Hist.* 2:59, 1946.
- BAYER, Emil (1875-1947). A., B., P., *Acta Soc. Zool. Cechosl.* 11:5-9, 1947.
- BAYNE, Arthur F. (1869-1947). A., P., *Rev. Soc. Ent. Arg.* 14:124-125, 1948.
- BAZILLE, Louis (1828-1886). Riley, C. V., *Scientific Amer.* 56:64, 1887.
- BEAURIEU, Gaspard Guillard de (1728-1795). Rose, H. J., *New Gen. Biog. Dict.* 3:453, 1850; Larousse, P., B., *Grand Dict. Univ. du xix Siècle* 2:447, 1865-76.
- BEAUVOIS (See under Palisot de Beauvois).
- BECCARI, Odoardo (1843-1920). Gestro, R., B., P., *Ann. Mus. Civ. Stor. Nat. Genova* 49:242-297, 1920-22.
- BECHER, Eduard (1856-1886). A., *Leopoldina* 23:53, 1887.
- BECHSTEIN, Johann Matthias (1757-1822). Rose, H. J., *New Gen. Biog. Dict.* 3:474, 1850; Larousse, P., B., *Grand Dict. Univ. du xix Siècle* 2:464, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 2:440, 1929; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 30-35, 1874.
- BECK, Heinrich Heinrichsen (1799-1863). Henriksen, K. L., *Ent. Meddelelser* 15:145-146, 1923.
- BECKER, Alexander (1818-1901). A., P., *Insekten-Börse* 18:153, 1901.
- BECKER, Leon (1826-1909). A., *Ent. Rundschau* 26:34, 1909; Lameere, A., *Ann. Soc. Ent. Belg.* 53:49, 1909; Horn, W., *Deutsche Ent. Ztschr.* p. 469, 1909; Bonnet, P., P., *Bibliographia Araneorum* 1:37, 1945.
- BECKER, Wilhelm Gottlieb (1753-1813). Rose, H. J., *New Gen. Biog. Dict.* 3:480, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:466, 1865-76.
- BECKMANN, Johann (1739-1811). Rose, H. J., *New Gen. Biog. Dict.* 3:492-493, 1850; Larousse, P., B., *Grand Dict. Univ. du xix Siècle* 2:467, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 2:445, 1929; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 35 (footnote), 1874.
- BECKWITH, Charles S. (1891-1944). Driggers, B. F., P., *Journ. Econ. Ent.* 37:569, 1944; A., *Ent. News* 55:215, 1944; Osborn, H., *Fragments Ent. Hist.* 2:60, 1946.
- BEDÉL, Ernest Marie Louis (1849-1922). Heikertinger, F., *Verh. Zool.-Bot. Ges. Wien* 74:75:(24), 1926; Bedel, M., P., (translated by W. M. Wheeler from *Livre Cent. Ent. Soc. France*), *Quart. Rev. Biol.* 8:325-330, 1933.
- BEDWELL, Ernest Charles (1875-1945). Massee, A. M., *Entomologist* 78:128, 1945; Harwood, P., *Ent. Mo. Mag.* 81:143, 1945; A., *Trans. Suffolk Nat. Soc.* 5:xcvii-xcviii, 1945.
- BEHN, Wilhelm Friedrich Georg (1808-1878). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 108 (footnote), 1874; Henriksen, K. L., *Ent. Meddelelser* 15:220, 1926.
- BEHR, Hans Hermann (1818-1904). A., *Insekten-Börse* 21:130, 1904.
- BEIJERINCK, Martinus Willem (1851-1931). Trotter, A., B., P., *Marcellia* 27:123-124, 1932.
- BEINLUNG, Theodor (1825-1900). Kletke, P., *Ztschr. f. Ent. (Breslau)* 25:26-27, 1900.
- BEIREIS, Gottfried Christoph (1730-1809). Rose, H. J., *New Gen. Biog. Dict.* 4:12, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:487, 1865-76.
- BELFRAGE, Gustaf Wilhelm (1834-1882). Riley, C. V., *American Nat.* 17:424, 1883.
- BELL, Alwin S. (-1877). Hewitson, W. C., *Ent. Mo. Mag.* 14:141, 1877.
- BELL, T. R. (-1948). Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (C)* 13:66-67, 1948-49.
- BELL-MARLEY, H. W. (1872(?) -1945). Whicher, L. S., *Ent. Mo. Mag.* 85:49, 1949.
- BELLARDI, Carlo Lodovico (1741-1828). Rose, H. J., *New Gen. Biog. Dict.* 4:33, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:505, 1865-76.

- BELLING, Hermann (1851(?)-1939). *Sachtleben*, Arb. morph. taxon. Ent. Berlin-Dahlem 6:349, 1939.
- BELON, Pierre (1517-1564). Rose, H. J., *New Gen. Biog. Dict.* 4:54-55, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:524-525, 1865-76.
- BENE, Giovanni di (1867-1938). A., P., *L'Apicoltore d'Ital.* 6:293-294, 1939.
- BENGTTSSON, Simon Fredrik (1860-1939). Ahlberg, O., *Ent. Tidskrift* 61:136-139, 1940; Brekke, R., *Norsk Ent. Tidsskrift* 6:47-48, 1941; Sachtleben, H., *Arb. physiol. angew. Ent. Berlin-Dahlem* 7:76, 1940.
- BENNIGSEN, H. E. Rudolf von (-1912). Morice, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:clxix, 1912.
- BERAUD, Jean Jacques (1753-1794). Rose, H. J., *New Gen. Biog. Dict.* 4:107, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:565, 1865-76.
- BERCIO, Hans (-1938). Heikertinger, F., *Koleopt. Rundschau* 25:78, 1939.
- BERENGER, Adolfo di (1815-1895). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 144 (footnote), 1874; Micheletti, L., B., *Bull. Soc. Botanica Ital.* pp. 132-137, 1895.
- BERG, Carl Heinrich Edmund von (1800-). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 38-43, 1874.
- BERG, Frederico Guillermo Carlos (1843-1902). A., *Ent. Mo. Mag.* 38:114, 1902; Gallardo, A., P., *Ann. Soc. Arg.* 43:273-279, 1897; Zeballos, E. S., B. only to 1897, *Bol. Inst. Geogr.* 18:71-82, 1897; Lizer y Trelles, C. A., *Curso de Entomologia* 1:33-34, 1947.
- BERG, Jens Frederik (1807-1847). *Natvig*, L. R., P., *Norsk Ent. Tidsskrift* 7:19-21, 1944.
- BERGE, Karl Friedrich (1811-1883). Rebel, H., *Ent. Ztschr. (Frankfurt)* 36:61, 64-65; 37:22-23, 1923-24.
- BERGEN, Carl August von (1704-1760). Rose, H. J., *New Gen. Biog. Dict.* 4:117, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:576, 1865-76.
- BERGER, Edward William (1869-1944). A., *Science* 100:350, 1944; A., *Journ. Econ. Ent.* 37:721, 1944; Creighton, J. T., *Ann. Ent. Soc. Amer.* 38:140, 1945; A., P., *Florida Ent.* 27:41-43, 1944; Osborn, H., *Fragments Ent. Hist.* 2:60-61, 1946; Osborn, H., P., *l. c.* p. 229, 1937.
- BERGIUS, Bengt (1723-1784). Rose, H. J., *New Gen. Biog. Dict.* 4:119, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:585, 1865-76.
- BERGIUS, Peter Jonas (1730-1790). Rose, H. J., *New Gen. Biog. Dict.* 4:119, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:585, 1865-76.
- BERGMAN, Torbern Olaf (1735-1784). Rose, H. J., *New Gen. Biog. Dict.* 4:120-122, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:585, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 2:562, 1929; Percheron, A., B., *Bibliographie Ent.* 1:22, 1834.
- BERGROTH, Ernst Evald (1857-1925). Torre-Bueno, J. R. de la, *Bull. Bklyn. Ent. Soc.* 43:152-153, 1948.
- BERGSTRÄSSER, Johann Andreas Benignus (1732-1812). Rose, H. J., *New Gen. Biog. Dict.* 4:122, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:586, 1865-76.
- BERKENHOUT, John (1730-1791). Rose, H. J., *New Gen. Biog. Dict.* 4:132-133, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:588, 1865-76.
- BERLEPSCH, Augustus von (1815-1877). Semonne, M., P., (translated), *Bee-Keepers Mag.* 6:1-2, 1878; Kanden, C., P., *L'Apiculteur* 21:367-369, 1877; A., P., *L'Apicultore* 10: 105-107, 1877.
- BERLESE, Antonio (1863-1927). Guercio, G. del, B., P., *Redia* 16:v-xix, 1927; Melis, A., P., *Riv. di Parassitol.* 9:1-4, 1948.
- BERLESE, Augusto Napoleone (1864-1903). Berlese, A., P., *Riv. Patol. Veg.* 10:347-349, 1901-03.
- BERNET KEMPERS, Karel Jan Willem (1867-1945). MacGillavry, D., B., *Ent. Berichten* 11:258-260, 1945.
- BERNHAEUER, Max (1866-1946). Jarvis, C. M., *Ent. Mo. Mag.* 82:160, 1946; Ram-bousek, F. G., et al., B., P., *Coleopt. Rundschau* 5:73-83, 1916; Schedl, K. E., *Zentralbl. Gesamtgeb. Ent.* 1:95, 1946; Heikertinger, F., P., *Koleopt. Rundschau* 22:187, 1936.

- BERNOULLI, John (1710-1790). Rose, H. J., *New Gen. Biog. Dict.* 4:160-161, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:606, 1865-76.
- BERNUTH, Emil von (1807-). Ratzeburg, J. T. C., B., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 43-45, 1874.
- BEROALDE DE VERVILLE, François de (1558-1612(?)). Rose, H. J., *New Gen. Biog. Dict.* 4:162-163, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:607-608, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 2:603, 1929.
- BERRO AGUILERA, Jesús María del (1888-1932). Cañizo, J. del, B., P., *Bol. Patol. Veg. y Ent. Agr.* 7:239-240, 1933; Cañizo, J. del, *Reseñas Cient. Soc. España Hist. Nat.* 7:148, 1932.
- BERTHOUMIEU, G. Victor (-1916). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:176, 1919; Joannis, J. de, *Bull. Soc. Ent. France* p. 309, 1916.
- BERTKAU, Philipp (1849-1895). A., *Ent. Mo. Mag.* 32:66, 1896; Verhoeff, C., B., *Ent. Nachrichten* 22:24-29, 1896; Bonnet, P., P., *Bibliographia Araneorum* 1:48, 1945.
- BERTOLINI, Stefano (1832-1905). Bergagli, P., *Bull. Soc. Ent. Ital.* 36:233-239, 1904 (1905).
- BESEKE (BESECKE), Johann Melchior Gottlieb (1746-1802). Rose, H. J., *New Gen. Biog. Dict.* 4:183, 1850.
- BESTER, W. (-1929). Auel, H., *Ent. Ztschr. (Frankfurt)* 43:29, 1929.
- BETHUNE-BAKER, George T. (1856(?)-1944). Wainwright, C. J., et al., *Ent. Mo. Mag.* 81:48, 1945; Turner, H. J., *Ent. Record* 57:35-36, 1945.
- BETTI, Zaccaria (1732-1788). Rose, H. J., *New Gen. Biog. Dict.* 4:193, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:654, 1865-76.
- BEYER, George E. (1861-1926). Viosca, P., Jr., *Science* 64:151, 1926.
- BEYER, Gustav (1840-1924). Leng, C. W., *Journ. N. Y. Ent. Soc.* 32:165-166, 1924.
- BEZZI, Mario (1868-1927). Parisi, B., B., P., *Atti Soc. Ital. Sci. Nat. Milano* 66:287-312, 1927; "G. B. T.," et al., P., *Riv. Soc. per gli Studi Trentini* 9:1-14, 1928.
- BHATTIA, Hira Lal (1901-1941). A., P., *Indian Journ. Ent.* 3:350-351, 1941.
- BIALINITZKY-BIRULA, Alexeandreevitch (1864-1937). A., *Festschrift Embrik Strand* 4:660-661, 1938.
- BIANCHI, Leo V. (-1936). A., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 3:151, 1936.
- BICKHARDT, Heinrich (1873-1920). Weber, L., B., P., *Ent. Blätter* 17:1-5, 1921.
- BIEBUYCK, Andre (-1945). Collart, A., *Bull. & Ann. Soc. Ent. Belg.* 81:53, 1945; A., *Lambillionea* 45:17, 1945.
- BIELZ, Eduard Albert (1827-1898). Csiki, E., B., P., *Rovartani Lapok (Budapest)* 7:1-4, German summary 7(1):1, 1900.
- BIENER, Christian Gottlob (1748-1828). Rose, H. J., *New Gen. Biog. Dict.* 4:232, 1850.
- BIERKANDER (BJERKANDER), Clas (1735-1795). Rose, H. J., *New Gen. Biog. Dict.* 4:233, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:722, 1865-76.
- BIGLAND, John (1759-1832). Rose, H. J., *New Gen. Biog. Dict.* 4:234, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:727, 1865-76.
- BIGNALL, George Carter (1826-1910). Keys, J. H., *Ent. Mo. Mag.* 46:94-95, 1910; Dixey, F. A., *Trans. Ent. Soc. Lond. (Proc.)*:lxxxvii, 1910; Morley, C., *Entomologist* 43:128, 1910.
- BILBERG (BILLBERG), Johann (1650-1717). Rose, H. J., *New Gen. Biog. Dict.* 4:239, 1850.
- BINDER, Adolf (1876-1935). Müller, L., B., *Ztschr. Österr. Ent.-Ver.* 20:30-32, 1935.
- BINGLEY, William (-1823). Rose, H. J., *New Gen. Biog. Dict.* 4:247, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:754, 1865-76.
- BINOT, Jean (1867(?)-1909). Horn, W., *Deutsche Ent. Ztschr.* p. 212, 1910.
- BIOLLEY, Paul (1862-1908). A., *Ent. Rundschau* 26:3-4, 1909.
- BIRCHALL, Edwin (1819(?)-1884). A., *Ent. Mo. Mag.* 21:23, 1884; A., *Psyche* 4:191, 1884; Dunning, J. W., *Trans. Ent. Soc. Lond. (Proc.)*:xlii, 1884.
- BIRKMANN, G. 1855-1944). A., *Science* 99:463, 1944.
- BISCHOF, Gustav Carl Christoph (1792-1870). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 47-49, 1874.

- BLACHIER, Charles Théodore (1859-1915). Reverdin, J. L., B., P., Bull. Soc. Lépidopt. Genève 3:119-122, 1916; Bethune-Baker, G. T., Ent. Record 28:23-24, 1916.
- BLACKBURN, Charles V. (1857(?) - 1944). A., Psyche 51:7, 1944.
- BLACKBURN, John Bickerton (1845-1881). A., Ent. Mo. Mag. 18:164, 1881.
- BLACKMAN, Mauley Willett (1876-1943). Schedl, K. E., Zentralbl. Gesamtgeb. Ent. 1:63, 1946; Hatch, M. H., Univ. Wash. Pub. Biol. 10 (footnote):148, 1945; Osborn, H., P., Fragments Ent. Hist. 2:61, 1946.
- BLACKMORE, Ernest Henry (1878-1929). A., Can. Ent. 61:218, 1929; Gunder, J. D., P., Ent. News 40:136, 1929.
- BLACKMORE, Trovey (1835-1876). A., Ent. Mo. Mag. 13:116, 1876; Westwood, J. O., Trans. Ent. Soc. Lond. (Proc.):xlili, 1876.
- BLACKWELL, John (1790-1881). (Some references say 1789). Bonnet, P., P., Bibliographie Araneorum 1:32-33, 1945.
- BLAES, Gerard (See under BLASIUS).
- BLAISDELL, Frank Ellsworth, Sr. (1862-1946). A., Calif. Acad. Sci. News Letter no. 80, pp. 2-4, 1946; A., Pan-Pacific Ent. 22:99, 1946; Van Dyke, E. C., B., P., Pan-Pacific Ent. 23:49-58, 1947; Tanner, V. M. Great Basin Nat. 7:17-20, 1946.
- BLANCHARD, Charles Emil (1819-1900). Porter, C. E., Rev. Chilena Hist. Nat. 38:111-112, 1934.
- BLANCHARD, Raphael Anatole Emile (1857-1919). Guiart, J., P., Archives Parasitol. 5:602-604, 1902; Moreau, E., Bull. Soc. Ent. France p. 69, 1919; Howard, L. O., P., Pop. Sci. Monthly 87:74, 1915.
- BLAND, Thomas (1809-1885). Proc. Biol. Soc. Wash. 4:127-129, 1886-88; P. only, Amer. Journ. Conch., 2:opp. p. 289, 1866; Gray, Arthur F., Complete list of scientific papers 1852-1883, Salem Press, 12 pp., 1884.
- BLASIUS (BLAES), Gerard (-1682). Rose, H. J., New Gen. Biog. Dict. 4:293, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:806, 1865-76.
- BLATCH, William Gabriel (1840(?) - 1900). Fowler, W. W., Ent. Mo. Mag. 36:89-90, 1900.
- BLATCHLEY, Willis Stanley (1859-1940). A., P., Proc. Indiana Acad. Sci. 50:1-2, 1941; Davis, J. J., Proc. Indiana Acad. Sci. 41:49-51, 1932; Tanner, V. M., Great Basin Nat. 2:33-35, 1941; Osborn, H., Fragments Ent. Hist. 2:62, 1946.
- BLAU, Carl (1839-1901). A., Insekten-Börse 18:90, 1901.
- BLEDOWSKI, Ryszard (1886-1932). "M. K.," P., Polskie Pismo Ent. 11:17-21, 1932.
- BLEGNY, Nicolas de (1652-1722). Rose, H. J., New Gen. Biog. Dict. 4:296-297, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:814, 1865-76.
- BLISS, Arthur (1858-1890). A., Entomologist 23:104, 1890.
- BLOCH, Mark Eliezar (1723-1799). Rose, H. J., New Gen. Biog. Dict. 4:301, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:830, 1865-76; Brockhaus, F. A., Der Grosse Brockhaus 3:27, 1929.
- BLOM, Carolus Magnus (1737-1815). Rose, H. J., New Gen. Biog. Dict. 4:303, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:833, 1865-76.
- BLOMEFIELD, Leonard (formerly Jenyns) (1800-1893). A., Ent. Mo. Mag. 29:239, 1893; Elwes, H. J., Trans. Ent. Soc. Lond. (Proc.):lv, 1893; A., Proc. Linn. Soc. Lond. p. 29, 1893-94; Winwood, H. H., P., Proc. Bath N. H. & Antiq. Field Club 8:35-55, 1894; Earle, J., et al., Hist. Berwickshire Nat. Club pp. 347-358, 1892-93.
- BLOOMFIELD, Edwin Newson (1827-1914). "E. A. B.," Ent. Mo. Mag. 50:157, 1914; A., Ent. Record 26:145, 1914.
- BLÜCHER, Friedrich (-1894). Kraatz, G., P., Deutsche Ent. Ztschr. pp. 7-8, 1894.
- BLUMENBACH, Johann Friedrich (1752-1840). Rose, H. J., New Gen. Biog. Dict. 4:319-320, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:839-840, 1865-76; Brockhaus, F. A., P., Der Grosse Brockhaus 3:36-37, 1929; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 54-55, 1874; Percheron, A., B., Bibliographie Ent. 1:33-34, 1834.
- BOCCONE, Paolo (1633-1704). Rose, H. J., New Gen. Biog. Dict. 4:330-331, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:848, 1865-76.
- BOCK, Friedrich Samuel (1716-1786). Rose, H. J., New Gen. Biog. Dict. 4:333-334, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:849, 1865-76.

- BODDAERT, Pieter (1730(?)-). Rose, H. J., *New Gen. Biog. Dict.* 4:338, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:850, 1865-76.
- BODE, Otto (1860-1904). Stichel, H., *Insekten-Börse* 21:385, 1904; Ziegler, F., P., *Berlin Ent. Ztschr.* 50:183-185, 1905.
- BODEMEYER, Bodo von (1883-1929). Heikertinger, F., *Koleopt. Rundschau* 16:33, 1930-31.
- BODEMEYER, Eduard von (1854-1918). Bodemeyer, B. von, P., *Ent. Ztschr. (Frankfurt)* 42:197-198, 1928.
- BOECK, Christian Peter Bianco (1798-1877). Natvig, L. R., P., *Norsk Ent. Tidsskr.* 7:15, 1944.
- BOEHMER, Georg Rudolph (1723-1803). Rose, H. J., *New Gen. Biog. Dict.* 4:354-355, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:856, 1865-76.
- BÖSENBERG, Friedrich Wilhelm (1841-1903). Bonnet, P., P., *Bibliographia Araneorum* 1:47, 1945.
- BÖTTCHER, August (-1900). A., P., *Insekten-Börse* 17:385, 1900.
- BOETTGER, Oskar (1844-1910). Haas, F., *Ent. Blätter* 6:267-268, 1910.
- BOHADSCH, Johannes Baptista (1724-1772). Rose, H. J., *New Gen. Biog. Dict.* 4:367-368, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:864, 1865-76.
- BOHATSCH, Otto (1843-1912). A., *Ent. Ztschr. (Frankfurt)* 26:128, 1912; Rebel, H., B., P., *Verh. Zool.-Bot. Ges. Wien* 62:(204)-(209), 1912.
- BOHEMAN, Carl Heinrich (1796-1868). Marseul, S. A. de, B., *L'Abeille, (Les Ent. et leurs Ecrits)* 22:141-144, 1884.
- BOIE, Friedrich (1789-1870). Ratzeburg, J. T. C., B., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 58-59, 1874.
- BOIELDIEU, Anatole Auguste (1824(?)-1886). Bourgeois, J., *Ann. Soc. Ent. France* (6) 6 (Bull.):lxxxix, 1886.
- BOILEAU, Henri (1866-1924). Didier, R., B., P., *Études sur les Coléoptères Lucanides du Globe* pp. 1-32, 1928.
- BOISDUVAL, Jean Baptiste Alphonse Dechauffour de (1799-1879). Hagen, H. A., B., only, *Bibliotheca Ent.* 1:64-66, 1862; Horn & Schenkling, B., only, *Index Litt. Ent.* 1:98-100, 1928; Lizer y Trelles, C. A., *Curso de Entomologia* 1:12, 1947.
- BOLIVAR Y URRUTIA, Ignacio (1850-1944). Cañizo, J. del, B., P., *Bol. Patol. Veg. y Ent. Agr.* 13:477-482, 1944; Liebermann, J., *Rev. Soc. Ent. Arg.* 12:336-338, 1944; Aguilo, F. de et al., *Rev. Acad. Columbiana de Cienc. Exact. Fis. y. Nat.* 6:158-159, 438, 442-446, 1945; A., P., *Eos*, 20 (enclosure): 2 unnumbered pp., 1945; Porter, C. E., P., *Rev. Chilena Hist. Nat.* 27:215-216, 1923; Burr, M., *Ent. Record* 34:203, 1922; Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:164-166, 187, 1919; Rioja, E., et al., P., *Cienca (Mex.)* 6:2-8, 97-100, 1945; Uvarov, B. P., *Nature* 156:74-75, 1945.
- BOLL, Jacob (1828-1880). Frey, H., *Mitt. Schweiz. Ent. Ges.* 6:47-51, 1880; Müller, K., *Die Natur* 29:646-647, 1880.
- BOLLMAN, Charles Harvey (1868-1889). Riley, C. V., B., *Bull. U. S. Nat. Mus.* 46:7, 1893.
- BOLTER, Andrew (1820-1900). Rapp, W. F., Jr., *Ent. News* 56:209, 1945.
- BOND, Frederick (1811-1889). Walsingham, Lord, *Trans. Ent. Soc. Lond. (Proc.):* lxxvii, 1889.
- BONNAIRE, Achille (1824(?)-1907). Lesne, P., *Bull. Soc. Ent. France* p. 85, 1907.
- BONNEFOIS, Aloys (1845(?)-1895). Giard, A., *Ann. Soc. Ent. France* 64 (Bull.): cclxxiv, 1895.
- BONNET, Amédée (-). Stempffer, H., *Bull. Soc. Ent. France* 49:2, 1944.
- BONNET, Charles (1720-1793). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 59-63, 1874; "F. N.," *Magasin Encyclopédique* 1:489-502, 1795.
- BONNIER, Jules (1859-1908). Keilin, D., P., *Parasitology* 15:110-111, 1923.
- BONPLAND, Aimé Jacques Alexandre Goujaud (1773-1858). Breyer, A., *Rev. Soc. Ent. Arg.* 11:380-381, 1942.
- BONY, G. de (-). Fage, L., *Bull. Soc. Ent. France* 40:97, 1935; A., *Miscellanea Ent.* 36:64, 1935.
- BORCH, Ole (See under BORRICHIUS, Olaus).
- BORCHMAN, Fritz Heinrich Christian (1870-1944). Gebien, H., B., P., *Verh. Ver.*

- Naturw. Heimatforschung Hamburg 29:xxi-xxvi, 1947; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 10:256, 1943.
- BORELLI, Alfredo (1881-1943). A., Ent. News 57:99, 1946; De Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 62:(4)-(5), 1945.
- BORELLI, Giovanni Alfonso (1608-1679). Rose, H. J., New Gen. Biog. Dict. 4:441, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1003, 1865-76; Brockhaus, F. A., Der Grosse Brockhaus 3:165, 1929.
- BORELLUS (BOREL), Petrus (1620-1689). Rose, H. J., New Gen. Biog. Dict. 4:440-441, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1002, 1865-76.
- BOREMAN, Thomas (). Weiss, H. B., Journ. N. Y. Ent. Soc. 47:213-217, 1939.
- BORKHAUSEN, Moriz Balthasar (1760-1806). Rose, H. J., New Gen. Biog. Dict. 4:446, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1007-1008, 1865-76; Brockhaus, F. A., Der Grosse Brockhaus 3:169, 1929; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 68-70, 1874.
- BORLASE, William (1696-1772). Rose, H. J., New Gen. Biog. Dict. 4:447, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1008, 1865-76.
- BORN, Paul (1859-1928). Bodemeyer, B. von, Ent. Anzeiger 8:117-118, 129-132, 137-140, 149-150, 157-160, 1928.
- BORNEMANN, Gustav (-1920). Hering, I. A., Deutsche Ent. Ztschr. Iris 35:53, 1921; Holze, A., Internat. Ent. Ztschr. (Guben) 14:185-186, 1921.
- BORREL, Amedée (1867-1936). A., Ann. Inst. Pasteur 57:337-342, 1936; Magrou, J., P., La Presse Méd. 44:1697-1698, 1936.
- BORRICHIVS (BORCH), Olaus (1626-1690). Rose, H. J., New Gen. Biog. Dict. 4:435-436, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:993, 1865-76.
- BORRIES, Herman (1860-1896). Henriksen, K. L., P., Ent. Meddelelser 12:24-25, 1918.
- BOS, Jan Ritzema (1850-1928). A., P., Tijdschr. over Plantenziekten 34:123-124, 1928; Schoevers, T. A. C., Landbouwk. Maandbl. Nederl. Genootsch. Landbouwwetenschap 40:201-204, 1928; "R. F.", La Tribune Horticole (Brussels) 13:256, 1928; Lovink, H. J., et al., Tijdschr. over Plantenziekten 35:1-2, 1929.
- BOSC D'ANTIC, Louis Auguste Guillaume (1759-1828). Rose, H. J., New Gen. Biog. Dict. 4:451, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1015, 1865-76; Cuvier, G. L. C. F. D., B., Mem. Acad. Sci. (Paris) 10:ccxi-ccxviii, 1827 (1831); Rey, A., P., Rev. Hist. Versailles et Seine-et-Oise 2:241-277, 1900; 3:17-42, 1901; Hellmayr, C. E., Alauda, (1) 2:122-132, 1930; Harper, F., Amer. Midl. Nat. 23:706-710, 1940; Dutrouilh, M., Seances Acad. Sci. Bordeaux pp. 143-150, 1829.
- BOSCH, Carl (1874-1940). Heikertinger, F., P., Koleopt. Rundschau 26:90-91, 1940.
- BOSE, Georg Matthias (1710-1761). Rose, H. J., New Gen. Biog. Dict. 4:455, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1017, 1865-76.
- BOSSCHE, Guilielmus van der (). Rose, H. J., New Gen. Biog. Dict. 4:457, 1850.
- BOTTONI, Dominique (1641-1731). Rose, H. J., New Gen. Biog. Dict. 4:464, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1042, 1865-76.
- BOUCHARD, Peter (-1865). Pascoe, F. P., Ent. Mo. Mag. 2:167, 1865.
- BOUCHÉ, Peter Friedrich (1784-1856). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 70-72, 1874.
- BOUCOMONT, Antoine (1868-1936). A., P., Miscellanea Ent. 37:91-92, 1936.
- BOUDIER, ÉMILE (1828-1920). Mangin, L., C. R. Acad. Sci. (Paris) 170:417-418, 1920.
- BOURGELAT, Claude (1712-1779). Rose, H. J., New Gen. Biog. Dict. 4:478-479, 1850; Larousse, P., Grand Dict. Univ. du xix Siècle 2:1120-1122, 1865-76; Brockhaus, F. A., Der Grosse Brockhaus 3:209, 1929.
- BOUVIER, Eugène (1856-1944). Stempfner, H., Bull. Soc. Ent. France 49:2, 1944; Jeannel, R., Bull. Mus. Hist. Nat. Paris (2) 16:7-10, 1944; Roubaud, E., P., Bull. Soc. Pathol. Exot. 37:66-70, 1944; Hitier, H., C. R. Acad. Agr. France 31:389-392, 1945; Fage, L., B., P., Ann. Sci. Nat. (Zool.) (11) 6:1-24, 1944; Hindle, E., Proc. Linn. Soc. Lond. 157:102-103, 1946; Porter, C. E., P., Rev. Chilena Hist. Nat. 39:401-402, 1935; Jeannel, R., B., P., Ann. Soc. Ent. France 113:1-30, 1944 (1946).

- BOWERBANK, James Scott (1797-1877). Carrington, J. T., *P.*, *Entomologist* 10:169-171, 1877; Westwood, J. O., *Trans. Ent. Soc. Lond. (Proc.)*:xxxix-xi, 1877.
- BOWKER, James Henry (-1900). "R. T.," *Proc. Linn. Soc. Lond.* 113:40-42, 1900-01.
- BOWLES, Guillermo (-1780). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:81-82, 1919.
- BOWRING, John Charles (1821-1893). *A.*, *Proc. Linn. Soc. Lond.* pp. 29-30, 1893-94.
- BOY, Hugo Carlos (-1937). Wucherpfennig, F., *Ent. Rundschau* 55:435, 1938.
- BOYD, Thomas (1829-1913). Gardner, W., *Ent. Record*, 25:31-32, 1913 *A.*, *Ent. Mo. Mag.* 49:38, 1913; Morice, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:clxiii-clxiv, 1912 (1913).
- BOYDYLLA, Georg (-1911). Soldanski, H., *Deutsche Ent. Ztschr.* pp. 100-101, 1912.
- BOYER, DE FONSCOLOMBE, Etienne Laurent Joseph Hippolyte (1772-1853). Mulsant, E., *B.*, *Opuscules Entomologiques* 2:129-144, 1853.
- BOYS, William (1735-1803). Rose, H. J., *New Gen. Biog. Dict.* 4:505, 1850.
- BRABANT, Georges Celestin Edouard (1849-1912). Lambillion, L. J., *Rev. Mens. Soc. Ent. Namuroise* 13:6-7, 1913; Morice, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:clxviii, 1912 *A.*, *Ent. Mo. Mag.* 49:21, 1913.
- BRADLEY, Richard (1675(?) -1732). Rose, H. J., *New Gen. Biog. Dict.* 4:511, 1850; Larousse, P., *Grand. Dict. Univ. du xix Siècle* 2:1186, 1865-76.
- BRAMSON, Constantin Ludwig (1842-1909). *A.*, *Ent. Rundschau* 27:22, 45, 1910.
- BRANDES, Gustav (1862-1941). Sachtleben, H., *Arb. Phys. Angew. Ent. Berlin-Dahlem* 9:55, 1942.
- BRANDT, Johann Friedrich (1802-1879). *A.*, *Botanische Zeitung* 37:743, 1879; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 72-76, 1874.
- BRANDZA, Marcel (1868-1934). Houard, C., *Marcellia* 28:xliv, 1932-33 (1935); Borza, A., *B.*, *P.*, *Bull. Jardin et Mus. Bot. Univ. Cluj (Roumania)* 14:199-210, 1934.
- BRANHAM, Henry G. (-1927). *A.*, *Florida Ent.* 11:12, 1927.
- BRANNON, Loyd William (1900-1948). Howard, N. F., *P.*, *Journ. Econ. Ent.* 41:527, 1948.
- BRAUER, August (1863-1917). Vanhöffen, E., *B.*, *P.*, *Mitt. Zool. Mus. Berlin* 9:1-2, 1918.
- BRAUER, Friedrich Moritz (1832-1904). *A.*, *P.*, *Insekten-Börse* 22:45-46, 1905; Csiki, E., *Rovartani Lapok (Budapest)* 12:65-66, 1905; Kusnezov, N. J., *B.*, *Rev. Russe d'Ent.* 5:93, 1905; Daniel, K., *Münchener Koleopt. Ztschr.* 2:390, 1906; Klapálek, F., *Casopis České Spol. Ent.* 2:79-81, 1905.
- BRAUN, Carl Friedrich Wilhelm (1800-1864). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 80, 1874.
- BRAUN, Karl (1870-1935). Speyer, W., *P.*, *Anzeiger für Schädlingkunde* 11:144, 1935.
- BREDDIN, Gustav (-1909). Dixey, F. A., *Trans. Ent. Soc. Lond. (Proc.)*:lxxxviii, 1910; *A.*, *Wiener Ent. Zeit.* 29:150, 1910; Horn, W., *Deutsche Ent. Ztschr.* p. 212, 1910.
- BREHM, Alfred Edmund (1829-1884). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 82-83, 1874.
- BREHM, Christian Ludwig (1787-1864). Dörner, H., *Aus der Heimath* pp. 433-436, 1864; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 80-82, 1874.
- BREIT, Julius (-1903). *A.*, *Insekten-Börse* 20:130, 1903.
- BREMER, Otto (-1873). *A.*, *Horae Soc. Ent. Ross.* 10:xxi, 1873.
- BREMI-WOLF, Johann Jacob (1791-1857). Menzel, A., *P.*, *An die Zürcherische Jugend* 60:1-56, 1858.
- BREMOND, François de (1713-1742). Rose, H. J., *New Gen. Biog. Dict.* 5:33, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1228, 1865-76.
- BRENSKE, Ernst (1845-1904). *A.*, *P.*, *Insekten-Börse* 21:297, 1904; Auel, H., *Ent. Ztschr. (Frankfurt)* 43:113, 1929.
- BRETHES, Juan (1871-1928). Dallas, E. D., *B.*, *P.*, *Rev. Soc. Ent. Arg.* 2:103-112, 1928; Lizer y Trelles, C. A., *Curso de Entomologia* 1:43-44, 1947.

- BREYN, Johann Philipp (1680-1764). Rose, H. J., *New Gen. Biog. Dict.* 5:50, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1258, 1865-76.
- BREZ, Jacques (1771-1798). Rose, H. J., *New Gen. Biog. Dict.* 5:50, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1258, 1865-76.
- BRIDGES, Calvin Blackman (1889-1938). Hoffman, C. C., P., *Anal. Inst. Biol. (Mex.)* 10:373-375, 1939. Morgan, T. H., B., P., *Nat. Acad. Sci. Biog. Mem.* 22:31-48, 1943; Morgan, T. H., et al., B., *Pub. Carnegie Inst.* 552:iii-vi, 253-257, 1944; Morgan, T. H., P., *Genetics* 25:i-v, 1940; Osborn, H., *Fragment Ent. Hist.* 2:62-63, 1946.
- BRIDGMAN, John Brooks (-1899). A., *Ent. Mo. Mag.* 35:293, 1899; Morley, C., *Ent. Mo. Mag.* 36:15-16, 1900.
- BRIGHTWEN, Elizabeth (-1906). Merrifield, F., *Trans. Ent. Soc. Lond. (Proc.)*:xlviii, 1906.
- BRIMLEY, Clement Samuel (1863-1946). Metcalf, Z. P., *Journ. Econ. Ent.* 40:141, 1947.
- BRINDLEY, Harold Hulme (1865-1944). Gardiner, J. S., *Nature* 153:309-310, 1944.
- BRINDLEY, Maud Doria Haviland (1891-1919). Rivière, B. B., *Ibis* (14) 5:619-621, 1941; Palmer, T. S., *Auk* 60:133-134, 1943; Thorpe, W. H., *Nature* 148:17-18, 1941.
- BRISCHKE, Carl Gustav A. (1814-1897). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 83-85, 1874; Van Rossum, A. J., *Ent. Berichten* 1:93, 1903.
- BRISOUT DE BARNEVILLE, Charles (1822-1893). A., *Ent. Mo. Mag.* 29:145, 1893; Lefèvre, E., *Ann. Soc. Ent. France* 62 (Bull.):cxcvi-cxcvii, 1893.
- BRITTON, G. F. J. M. (-1940). "D. M.," *Trans. & Proc. Roy. Soc. N. Z.* 70:xxxvii-xxxviii, 1940.
- BRITTON, Wilton Everett (1868-1939). Felt, E. P., P., *Mass. State Coll. Fernald Club Yearbook* 9:1-6, 1940; Osborn, H., *Fragments Ent. Hist.* 2:63, 1946.
- BRODIE, Peter Bellinger (1815-1897). Trimen, R., *Trans. Ent. Soc. Lond. (Proc.)*:72, 1897.
- BROERSE, J. (1875-1940). Corporaal, J. B., *Ent. Berichten* 10:213-214, 1940.
- BROGIANI, Dominico (1716-). Rose, H. J., *New Gen. Biog. Dict.* 5:82, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1300, 1865-76.
- BROMBACHER, Ernst (1879-1935). Von der Goltz, D., *Internat. Ent. Ztschr. (Guben)* 28:549-550, 1935.
- BRONGNIART, Charles Jules Edme (1859-1899). A., *Ent. Mo. Mag.* 35:148, 1899; Verrall, G. H., *Trans. Ent. Soc. Lond. (Proc.)*:xxxvii, 1899; Milne Edwards, H., et al., *Bull. Mus. Hist. Nat. (Paris)* 5:141-144, 1899; Bouvier, E. L., *Bull. Soc. Ent. France* pp. 141-142, 1899.
- BROWN, Heinrich Georg (1800-1862). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 85-87, 1874.
- BROOKS, George Shirley (1872-1947). Wallis, J. B., *Lepidopterists' News* 2:1, 1948.
- BROOKS, William (-1916). A., *Ent. Record* 28:117, 1916.
- BROTIER, Gabriel (1723-1789). Rose, H. J., *New Gen. Biog. Dict.* 5:96, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1314, 1865-76.
- BROUN, Thomas (1838-1919). A., *Ent. Mo. Mag.* 55:264, 1919; Cheeseman, T. F., P., *Trans. & Proc. N. Z. Inst.* 52:ix-x, 1920.
- BROWN, Edwin (1819-1876). Westwood, J. O., *Trans. Ent. Soc. Lond. (Proc.)*:xliii, 1876.
- BROWN, John (-1909). Dixey, F. A., *Trans. Ent. Soc. Lond. (Proc.)*:lxxxviii, 1909.
- BROWNE, Patrick (1720-1790). Rose, H. J., *New Gen. Biog. Dict.* 5:112, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1325, 1865-76.
- BROWNE, Thomas (1605-1682). Rose, H. J., *New Gen. Biog. Dict.* 5:114-115, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1324, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 3:387, 1929.
- BROWNE, William George (1768-1813). Rose, H. J., *New Gen. Biog. Dict.* 5:119-120, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1325, 1865-76.
- BRUCE, James (1730-1794). Rose, H. J., *New Gen. Biog. Dict.* 5:127-131, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1330, 1865-76.

- BRUCH, Carlos (1873-1943). Lizer, C., B., *Physis* (Arg.) 7:213-227, 1924; B., only, *Rev. Soc. Ent. Arg.* 9:13-21, 1937; Lizer y Trelles, C. A., et al., B., P., *Rev. Soc. Ent. Arg.* 12:48-56, 71-91, 1943; Lizer y Trelles, C. A., et al., B., P., *An. Soc. Cient. Arg.* 137:169-183, 1943; Birabén, M., B., P., *Rev. La Plata Univ. Nat. Mus. Secc. Ofic.* pp. 107-132, 1943 (1944); Schedl, K. E., *Zentralbl. Gesamtgeb. Ent.* 1:63, 1946; "C. L. T.," *Physis* (Arg.): 11:524-525, 1935; A., *Physis* (Arg) 10:436-438, 1931; Lizer y Trelles, C. A., *Curso de Entomología* 1:41-42, 1947.
- BRÜCKMANN, Franz Ernst (1697-1753). Rose, H. J., *New Gen. Biog. Dict.* 5:134, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1331, 1865-76.
- BRÜNNICH, Karl (-1940). A., *Bee World* 21(10):93, 1940.
- BRÜNNICH, Martin Thrane (1737-1827). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* p. 52, 1836.
- BRUG, Steffen Lambert (1879-1946). Van Eyndhoven, G. L., *Ent. Berichten* 12:112, 1947; Pick, F., *Bull. Soc. Pathol. Exot.* 41:107-109, 1948.
- BRUGNATELLI, Luigi Gasparo (1761-1818). Rose, H. J., *New Gen. Biog. Dict.* 5:138, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1334, 1865-76.
- BRUNER, Lawrence (1856-1937). Osborn, H., *Fragments Ent. Hist.* 2:64, 1946.
- BRUNETTI, Enrico Adelelmo (1862-1927). Smart, J., B., *Journ. Soc. Bibl. Nat. Hist.* 2:35-38, 1945; Alexander, C. P., *Rec. Indian Mus.* 44:31-32, 1942.
- BRUNICKI, Julian (1864-1924). Schille, F., *Polskie Pismo Ent.* 3:1-2, 1924.
- BRUNNER, Johann Conrad (1653-1727). Rose, H. J., *New Gen. Biog. Dict.* 5:156-157, 1850.
- BUBACEK, Otto (1872-1934). Reisser, H., P., *Ztschr. Österr. Ent. Ver.* 19:57-62, 1934.
- BUCHOZ (BUC'HOZ), Pierre Joseph (1731-1807). Rose, H. J., B., *New Gen. Biog. Dict.* 5:187, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1377, 1865-76.
- BUCHWALD, Balthasar Johannes (1697-1763). Rose, H. J., *New Gen. Biog. Dict.* 5:187-188, 1850.
- BUCKLE, Claude W. (-1904). A., *Irish Nat.* 13:156, 1904.
- BUCKLER, William (1814-1884). Russell, S. G. C., *Ent. Record* 56:38, 1944.
- BUDE-LUND, Gustav (1846-1911). Henriksen, K. L., P., *Ent. Meddelelser* 12:16, 1918.
- BUDDEBERG, Carl Dietrich (1840-1909). Horn, W., *Deutsche Ent. Ztschr.* pp. 211-212, 1910; A., *Ent. Rundschau* 27:10-11, 1910.
- BÜCHNER, Jean Andreas Elias (1701-1769). Rose, H. J., *New Gen. Biog. Dict.* 5:196-197, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1376, 1865-76; Rumpel, H. E., *Nova Acta Acad. Leopoldina Carolinae Nat. Cur.* 4 (appendix); 299-314, 1770.
- BUENO, J. R. de la Torre. (See under TORRE-BUENO).
- BÜSCHING, Anton Friedrich (1724-1793). Rose, H. J., *New Gen. Biog. Dict.* 5:317-318, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1438, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 3:552, 1929.
- BUETTNER, David Sigismund Augustus (1724-1768). Rose, H. J., *New Gen. Biog. Dict.* 5:198-199, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1448, 1865-76.
- BUFFON, George Louis Leclerc de (1707-1788). Rose, H. J., *New Gen. Biog. Dict.* 5:199-202, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1390-1392, 1865-76; Brockhaus, F. A., P., *Der Grosse Brockhaus* 3:483, 1929; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 92-94, 1874.
- BUGNION, Frederic Edouard (1845-1939). Sachtleben, H., *Arb. phys. angew. Ent. Berlin-Dahlem* 7:168-169, 1940.
- BULLER, Arthur Henry Reginald (1874-1944). Brooks, F. T., B., P., *Obit. Notices Fellows Roy. Soc.* 5:51-59, 1945.
- BUNGE, Hermann (1870-1929). Von Barga, A., *Verh. Ver. Naturw. Heimatforschung* (Hamburg) 21:xxiii-xxiv, 1929.
- BUNIVA, Michael Francis (1761-1834). Rose, H. J., *New Gen. Biog. Dict.* 5:217, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1413, 1865-76.
- BUQUET, Jean Baptiste Lucien (1807-1889). A., *Ent. Mo. Mag.* 26:53, 1890.
- BURGSDORF, Friedrich August Ludwig von (1747-1802). Rose, H. J., *New Gen. Biog. Dict.* 5:277, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1426, 1865-

- 76; Brockhaus, F. A., *Der Grosse Brockhaus* 3:534, 1929; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 98-101, 1874.
- BURLESON, Thomas William (-1944). Root, E. R., P., *Gleanings in Bee Culture* 73:55, 1945.
- BURMEISTER, Hermann Carl Conrad (1807-1892). Taschenberg, O., B., *Leopoldina* 29:43-46, 62-64, 78-82, 94-97, 1893; Berg, C. Stettin. *Ent. Zeit.* 53:176, 1892; A., *Insekten-Börse* 9 (16):unpaged, 1892; Boucard, A., *The Hummingbird* 2:134, 1892; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 101-104, 1874; A., P., *Physis* (Arg.) 3:305-306, 1917; Cardoso, A., P., *Rev. Soc. Ent. Arg.* 12:159-165, 1944; Lizer y Trelles, C. A., *Curso de Entomologia* 1:30-31, 1947.
- BURNET, Thomas (1635-1715). Rose, H. J., *New Gen. Biog. Dict.* 5:298-300, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1432, 1865-76.
- BURNEY, Henry (1813-1893). A., *Ent. Record* 4:245, 1893; Elwes, H. J., *Trans. Ent. Soc. Lond. (Proc.)* lvi, 1893.
- BURY, Herbert (1871-1939). Jackson, J. W., *North Western Nat.* 15:71-72, 1940.
- BUSCK, August (1870-1944). A., *Ent. News* 55:158, 1944; Heinrich, C., et al., B., P., *Proc. Ent. Soc. Wash.* 46:231-239, 1944; Henriksen, K., *Ent. Meddelelser* 15:506, 1937.
- BUTLER, Charles (1560-1647). Rose, H. J., *New Gen. Biog. Dict.* 5:327-329, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1445, 1865-76.
- BUXBAUM, Johann Christian (1694-1730). Rose, H. J., *New Gen. Biog. Dict.* 5:335, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 2:1452, 1865-76.
- BUXTON, E. C. (-1878). Carrington, J. T., *Entomologist* 12:63-64, 1879.
- CADA-MOSTO (CADAMOSTO, CA DA MOSTO), Aloys (Alvise) Luigi da (1432-1480(?)). Rose, H. J., *New Gen. Biog. Dict.* 5:364-365, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 3:37, 1865-76; Brockhaus, F. A., *Der Grosse Brockhaus* 3:584, 1929.
- CAFLISCH, J. Lucius (-1900). A., P., *Insekten-Börse* 17:121-122, 1900.
- CAGNATI, Marsilius (1543-1612). Rose, H. J., *New Gen. Biog. Dict.* 5:391, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 3:68, 1865-76.
- CAILLE, Jean de la (-1720). Larousse, P., *Grand Dict. Univ. du xix Siècle* 3:79, 1865-76.
- CALDER, Edwin Eddy (1853-1929). Engelhardt, G., *Bull. Bklyn. Ent. Soc.* 24:115, 1929.
- CALMBACH, Viktor (-1941). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 8:77, 1941.
- CALVERT, Robert (-1891). South, R., *Entomologist* 24:104, 1891.
- CAMBRIDGE, Octavius Pickard (1835-1917). A., *Physis* (Arg.) 3:313, 1917.
- CAMERARIUS, Elias (1673-1734). Rose, H. J., *New Gen. Biog. Dict.* 5:454, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 3:209, 1865-76.
- CAMERARIUS, Joachim II (1534-1598). Rose, H. J., *New Gen. Biog. Dict.* 5:453-454, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 3:209, 1865-76.
- CAMERARIUS, Johann Rudolph (-). Larousse, P., *Grand Dict. Univ. du xix Siècle* 3:209, 1865-76.
- CAMERARIUS, Rudolph Jacob (1665-1721). Rose, H. J., *New Gen. Biog. Dict.* 5:454, 1850; Larousse, P., *Grand Dict. Univ. du xix Siècle* 3:209, 1865-76.
- CAMPBELL, Charles (-1873). A., *Ent. Mo. Mag.* 10:183, 1874.
- CAMPBELL, Robert Walter (1872-1912). A., *Deutsche Ent. Ztschr.* p. 608, 1912.
- CAMPOS, Francisco (1878-1943). A., *Journ. Econ. Ent.* 36:247, 1943; García, A. A., et al., *Rev. Col. Nac. Vicente Rocafuerte* 12(42-43):171-191, 1930; B. only, *Guayquil*, 9 pp., 1932.
- CANDÈZE, Ernest Charles Auguste (1827-1898). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 104-105, 1874; Lameere, A., P., *Insekten-Börse* 15:209, 1898; Fraipont, J., B., P., *Mem. Soc. Sci. Liège* (3) 1:3-18, 1899; Kerremans, C., *Ann. Soc. Ent. Belg.* 42:269, 1898.
- CANE, Harry (1860-1935). Foxlee, H. R., P., *Proc. Ent. Soc. Br. Columbia* 43:45-46, 1947.
- CANESTRINI, Giovanni (1835-1900). Pasquini, P., B., P., *Riv. Biol. (Firenze)* 22:132-154, 1937; Bonnet, P., P., *Bibliographia Araneorum* 1:41, 1945.

- CANESTRINI, Ricardo (1858-1892). *A.*, Leopoldina 28:56, 1892.
- CANTIPRATENUS (CANTIPRATANUS or DE CANTIMPRÉ), Thomas (-1270(?)). Rose, H. J., *New Gen. Biog. Dict.* 5:505, 1850.
- CAPOMONT, Guillaume (1812-1871). *Marseul, S. de, B. only, L'Abeille*, 21 (*Les Ent. et leurs Écrits*):61, 1883.
- CAPPER, Samuel James (1825-1912). Porritt, G. T., *Ent. Mo. Mag.* 48:68-69, 1912; Turner, H. J., *Ent. Record* 24:52, 1912; *A.*, *Entomologist* 45:139-140, 1912; Morice, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:clxiii, 1912.
- CAPRONNIER, Jean Baptiste (1814-1891). Giron, A., *Ann. Soc. Ent. Belg.* 35 (C. R.):cccxxiii, 1891; Thieme, U., *Allgem. Lezikon Bild. Künstler* 5:558-559, 1911.
- CARADJA, Aristide (1861-1945). Savulescu, T., *B., P., Anal. Acad. Romane, Mem. Sect. Stiint.* (3) 20 (*Mem. 8*):1-28, 1945; *A.*, *Mitt. Deutsch. Ent. Ges.* 7:33-37, 1936.
- CARDEN, George (-1894). Goss, H., *Ent. Mo. Mag.* 30:65, 1894; "H. G.," *Entomologist* 27:108, 1894; Elwes, H. J., *Trans. Ent. Soc. Lond. (Proc.)*:li, 1894.
- CARL, Jean (1877-1944). *A.*, *Ent. News* 56:279-280, 1945; "A. P.," *P., Mitt. Schweiz. Ent. Ges.* 19:217-225, 1945; Revilliod, P., *B., P., Verh. Schweiz. Naturf. Ges.* 124:311-317, 1944.
- CARLET, Gaston (1845-1892). Kilian, H., *Le Naturaliste* 14:152-153, 1892; Jourdeuille, C., *Ann. Soc. Ent. France* 61 (*Bull.*):ccxix, 1892; Chaumat, H., *B., Bull. Soc. Statist. Sci. Nat. Isère* (4) 1:403-451, 1892.
- CARPENTER, George Herbert (1865-1939). *A., P., North Western Nat.* 14:2, 50-51, 1939; "C. B. M.," *P., Irish Nat. Journ.* 7:138-141, 1939; Bonnet, P., *Bibliographia Araneorum* 1:51-52, 1945.
- CARPENTIER, Charles (-). *A.*, *Miscellanea Ent.* 36:92, 1935.
- CARR, John Wesley (1862-1939). *A.*, *North Western Nat.* 14:81, 1939.
- CARRERO, Eduardo (-1842). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:83, 1919.
- CARRET, A. (Abbé) (-1907). Daniel, K., *Münch. Koleopt. Ztschr.* 3:399, 1908.
- CARROLL, James (1854-1907). Howard, L. O., *P., Pop. Sci. Monthly* 87:177, 1915; *A., P., Journ. Amer. Med. Assoc.* 49:1048, 1907.
- CARTER, Henry Rose (1852-1925). *A., P., Amer. Journ. Pub. Health* 15:994, 1925; *A., P., Amer. Journ. Trop. Med.* 5:385-388, 1925.
- CARTER, Herbert James (1858-1940). Zeck, E. H., *Australian Nat.* 10:273-274, 1941; "A. B. W.," *P., Proc. Linn. Soc. N. S. Wales* 68:91-94, 1943.
- CARTHEUSER, Johann Friedrich (1704-1777). Rose, H. J., *New Gen. Biog. Dict.* 6:82-83, 1850.
- CARUS, Carl Gustav (1789-1869). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 108-111, 1874.
- CARUS, Julius Victor (1823-1903). *A., P., Insekten-Börse* 20:97, 1903; *A.*, *Proc. Linn. Soc. Lond.*, 115th Sess.:28, 1902-03; Hanstein, R. von, *Naturwiss. Rundschau* 18:245-246, 1903.
- CASEY, Thomas Lincoln (1857-1925). Arnett, R. H., Jr., *Coleopterists' Bull.* 1:67-68, 1941.
- CASPARI, W., Jr. (-1909). *A.*, *Ent. Rundschau* 26:81, 1909.
- CASSIN, John (1813-1869). Stone, W., *P., Cassinia* 5:1-7, 1901.
- CASTEK, Josef (1872-1941). Tykač, J., *P., Acta Soc. Ent. Bohemiae* 38:6-7, 1941.
- CASTELNAU, François Louis Nompard de Caumont de Laporte de (1810-1880). Fauvel, A., *Annuaire Ent. pp.* 114-115, 1881; *Marseul, S. A. de, B. only, L'Abeille* 24 (*Les Entom. et leur Écrits*):145-147, 1887.
- CATESBY, Mark (1679-1749). Rose, H. J., *New Gen. Biog. Dict.* 6:115-116, 1850; Brendel, F., *American Nat.* 13:755, 1879; Hume, H. H., *Florida Hist. Quart.* 21:292, 1943; Stone, W., *Bird-Lore* 7:126-129, 1905; Allen, E. G., *Auk* 54:349-363, 1937; Stone, W., *Auk* 46:447-454, 1929; Rees' *Encyclopedia* 7:2 pp. (un-numbered), 1819; "W. H. B. C.," *Dict. Amer. Biog.* 3:571-572, 1929; Hagen, H. A., *Stett. Ent. Zeit.* 51:243-245, 1890.
- CAVANNA, Guelfo (1850-1920). Balducci, E., et al., *B., Ann. Mus. Stor. Nat. Genova* 49:194-207, 1920-22.
- CAVOLINI (CAULINUS), Filippo (1756-1810). Rose, H. J., *New Gen. Biog. Dict.* 6:146, 1850; Hope, F. W., *Trans. Ent. Soc. Lond.* 4:xix, 1845-47.
- CECONI, Giacomo (1866-1941). Trotter, A., *Marcellia* 30:xlvi, 1942.

- CELLI, Angelo (1859-1914). Howard, L. O., *P.*, *Pop. Sci. Monthly* 87:72, 1915; De Blasi, P., *Deutsche Med. Wochenschr.* 40:2131, 1914.
- CELSIUS, Olaus (1670-1756). Rose, H. J., *New Gen. Biol. Dict.* 6:163, 1850.
- CERNOSVITOV, Lev (1902-1945). Trewavas, E., *Nature* 157:219-220, 1946.
- CESTONI, Giacinto (Hyacinthe) (1637-1718). Baglioni, S., *P.*, *Riv. di Parassitol.* 6:1-12, 1942.
- CHAGAS, Carlos Justiniano Ribeiro dos (1879-1934). *A.*, *Journ. Parasitol.* 21:122-123, 1935; Sámamo, A., *Anal. Inst. Biol. Mex.* 6:2, 1935.
- CHAGAS, Evandro Serafim Lobo (1905-1940). *A.*, *Rev. Ent. (Brasil)* 11:968, 1940; "T. F." *Rev. Brasil. de Biol.* 1:114-115, 1941; Villela, E. de A., *B.*, *P.*, *Mem. Inst. Oswaldo Cruz* 36:xxxiii-xliiii, 1941.
- CHAMBERLIN, K. F. (-1948). *A.*, *Science* 107:291, 1948.
- CHAMBERS, Victor Toucey (1830-1883). Mann, B. P., *Psyche* 4:94, 1883; Riley, C. V., *Amer. Nat.* 17:1072, 1883; Osborn, H., *Fragments Ent. Hist.* 2:64-65, 1946.
- CHAMPION, George Charles (1851-1927). *A.*, *Cent. Hist. Ent. Soc. Lond.* pp. 153-154, 1933.
- CHAMPOLLION, FIGEAC, Jean François (1790-1831). Rose, H. J., *New Gen. Biog. Dict.* 6:198-199, 1850.
- CHANAY, William (-1906). Walker, J. J., *Ent. Mo. Mag.* 43:16-17, 1907; *A.*, *Ent. Record* 19:28, 1907.
- CHANT, John (-1867). Newman, E., *Entomologist* 4:106-107, 1868.
- CHAPELIER, Abbé (-1861). "A. A." *Mem. Soc. Sci. Phys. et Nat. Dept. d'Ille-et-Vilaine (Rennes)* 1:47, 1863.
- CHAPIN, S. F. (1839-1889). Essig, E. O., *Hist. of Ent.* p. 567, 1931.
- CHAPMAN, Royal Norton (1889-1939). Carter, W., *Science* 91:255-256, 1940; *A.*, *Journ. Econ. Ent.* 32:896, 1939; Sachtleben, H., *Arb. physiol. angew. Ent. Berlin-Dahlem* 7:169, 1940; Friederichs, K., *Anzeiger Schädlingk.* 16:84, 1940; Osborn, H., *Fragments Ent. Hist.* 2:65-66, 1946.
- CHAPMAN, Thomas (1816-1879). Carrington, J. T., *Entomologist* 12:299-300, 1879; *A.*, *Scottish Nat.* 5:236, 1879-80.
- CHAPPELL, Joseph (1830-1896). Bailey, J. H., *Ent. Mo. Mag.* 32:262, 1896; *A.*, *Entomologist* 29:376, 1896.
- CHAPIUS, Felicien (1824-1879). Marseul, S. A. de, *B.* only, *L'Abeille* 20 (Les Entom. et leurs Écrits):42-43, 1882; Fauvel, A., *Annuaire Ent.* pp. 119-120, 1880; Candeze, E., *P.*, *Ann. Acad. Belg.* 46:357-372, 1880; Ratzeburg, J. T. C., *B.*, *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 110-111, 1874.
- CHARLETON, Walter (1619-1707). Rose, H. J., *New Gen. Biog. Dict.* 6:246-247, 1850.
- CHARLEVOIX, Pierre François Xavier (1682-1761). Rose, H. J., *New Gen. Biog. Dict.* 6:247-248, 1850.
- CHASTER, George William (-1910). *A.*, *Ent. Mo. Mag.* 46:145-146, 1910.
- CHAUDOIR, Maximilien de (1816-1881). Putzeys, J., *Ann. Soc. Ent. Belg. (C. R.)* 25:lxxxviii-lxxxix, 1881; Putzeys, J. (trans. by C. A. Dohrn), *Stettiner Ent. Zeit.* 42:444-445, 1881; Kraatz, *Deutsche Ent. Ztschr.* 25:341-342, 1881; Marseul, S. A. de, *B.* only, *L'Abeille* 20 (Les Entom. et leurs Écrits):6-11, 1882; Marseul, S. A., *L'Abeille* 18 (Nouv. et Faits Divers (2) 36):143-144, 1881; Bordsas, L., *P.*, *Insecta* 11:24, 1921.
- CHAUSSIER, François (1746-1828). Rose, H. J., *New Gen. Biog. Dict.* 6:264, 1850.
- CHAVANNES, Jacques Auguste (1810-1879). Blanc, H., *P.*, *Verh. Schweiz. Naturf. Ges.* 92:33-39, 1909.
- CHEMNITZ, Johann Hieronymus (1730-1800). Rose, H. J., *New Gen. Biog. Dict.* 6:268, 1850.
- CHEVALIER, Louis (1851-1929). *A.*, *P.*, *Bull. Soc. Sci. Nat. Seine-et-Oise* (2) 10:65-71, 1929.
- CHEVROLAT, Louis Alexandre Auguste (1799-1884). Marseul, S. A., de, *B.* only, *L'Abeille* 24:(Les Entom. et leurs Écrits):148-164, 1887.
- CHILDREN, John George (1777-1852). *A.*, *Proc. Linn. Soc. Lond.* 2:183-185, 1852.
- CHOPRA, R. L. (-1942). *A.*, *Indian Journ. Ent.* 4:97, 1942.
- CHRÉTIEN, Pierre (-1934). *A.*, *Lambillionea* 34:149, 1934; Peyerimhoff, P. de, *Bull. Soc. Ent. France* 39:177, 1934.
- CHRISTIANI, Olaf Gudmann (1877-1944). West, A., *Ent. Meddelelser* 25:148, 1947.

- CHRISTOPH, Hugo Theodor (1831-1894). Elwes, H. J., Trans. Ent. Soc. Lond. (Proc.):lii, 1894.
- CHRISTY, John Fell (-1851). Westwood, J. O., Trans. Ent. Soc. Lond. n. s. 1 (Proc.):135, 1851.
- CHYZER, Kornelius (1836-1909). A., Ent. Rundschau 26:145, 1909; Bonnet, P., P., Bibliographia Araneorum 1:42, 1945.
- CIRILLO (CYRILLO), Domenico (1730-1799). Rose, H. J., New Gen. Biog. Dict. 6:328, 1850.
- CIST, Jacob (1782-1825). Weiss, H. B., Pioneer century of American entomology pp. 103-104, 1936.
- CLAASEN, Peter Walter (1886-1937). Osborn, H., Fragments Ent. Hist. 2:66, 1946.
- CLAES, Edgard (-1895). Selys-Longchamps, E. de, Ann. Soc. Ent. Belg. 39:241-242, 1895.
- CLAIRVILLE, Joseph Philippe de (1742-1830). Geilinger, P., Mitt. Naturw. Ges. Winterthur 19:281-288, 1935.
- CLARK, Benjamin Preston (1860-1939). Usinger, R. L., Pan-Pacific Ent. 15:90, 1939.
- CLARK, Bracy (1771-1860). Douglas, J. W., Trans. Ent. Soc. Lond. n. s. 5 (Proc.):148-149, 1860.
- CLARK, Edgar James (-1945). Carpenter, G. D. H., Ent. Mo. Mag. 81:143, 1945.
- CLARK, John Adolphus (1842-1908). Sequeira, J. S., et al., Ent. Record 21:22-24, 1909; Waterhouse, C. O., Trans. Ent. Soc. Lond. (Proc.):cvii, 1908; A., Ent. Rundschau 26:15, 1909; "O. E. J.," Entomologist 42:48, 1909.
- CLARKE, Alexander Henry (1839-1911). Turner, H. J., Ent. Record 23:256, 1911; Porritt, G. T., Ent. Mo. Mag. 47:264, 1911; Morice, F. D., Trans. Ent. Soc. Lond. (Proc.):cxxiii, 1911.
- CLARKE, Edward Daniel (1769-1822). Rose, H. J., New Gen. Biog. Dict. 6:341-342, 1850.
- CLAUS, Carl (1835-1898). Grobben, C., Verh. Zool.-Bot. Ges. Wien 49:112-116, 1899.
- CLERCK, Carl Alexander (1710-1765). Eisel, J. N., Geschichte, Systematik und Literatur der Insektenkunde p. 45, 1836; Rose, H. J., New Gen. Biog. Dict. 6:365, 1850; Bonnet, P., Bibliographia Araneorum p. 28, 1945.
- CLOSS, Adolf G. (1864-1938). A., Arb. Morph. Taxon. Ent. Berlin-Dahlem 5:352, 1938.
- CLUSIUS, Alfred (1867-1909). Horn, W., Deutsche Ent. Ztschr. p. 113, 1910.
- CLUTTIUS, Augerius (See under CLUYT, Auger).
- CLUYT, Auger (-). Rose, H. J., New Gen. Biog. Dict. 6:378, 1850.
- CLUYT, Theodore Auger (-). Rose, H. J., New Gen. Biog. Dict. 6:378, 1850.
- COBO, Bernabé (1572-1659). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:77, 1919.
- COCKERELL, Theodore Dru Alison (1866-1948). Rohwer, S. A., P., Proc. Ent. Soc. Wash. 50:103-108, 1948; Remington, C. & J., Lepidopterists' News 2:14, 1948; Schwarz, H. F., P., Ent. News 59:85-89, 1948; Carpenter, F. M., et al., P., Psyche 55: 35, 1948; Michener, C. D., P., Journ. N. Y. Ent. Soc. 56:171-174, 1948; Linsley, E. G., P., Bull. Bklyn. Ent. Soc. 43:116-118, 1948; Eyer, J. R., P., Journ. Econ. Ent. 42:166-167, 1949; James, M. T., Ann. Ent. Soc. Amer. 42:235-237, 1949; Essig, E. O., Pan-Pacific Ent. 24:117-121, 1948; Rayment, T., Victorian Nat. 64:225-226, 1948; Howard, L. O., Hist. Applied Ent. 1930; Jaeger, E. C., P., 3rd Ann. Rpt. Palm Springs Desert Mus. pp. 30-31, 1947; Taft, R., P., Trans. Kansas Acad. Sci. 48:42-44, 1945; Le Veque, N., P., Colorado Mt. Club 303:27-29, 34, 1944; Williams, C. B., Proc. Roy. Ent. Soc. Lond. (C) 13:67, 1948-49; Essig, E. O., P., Hist. of Ent. pp. 570-573, 1931; Bonnet, P., Bibliographia Araneorum 1:62-63, 1945.
- COCKLE, George (-1900). Verrall, G. H., Trans. Ent. Soc. Lond. (Proc.):xiv, 1900.
- CODINA, Ascensio (1877-1932). Español, F., P., Butl. Inst. Catalana Hist. Nat. 32:239-242, 1932; Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:191, 1919.
- COLEBROOK (COLEBROOKE), Henry Thomas (1765-1782). Rose, H. J., New Gen. Biog. Dict. p. 399, 1850.
- COLENZO, William (1811-1899). A., Nature 59:420, 1899.

- COLLINS, Charles Walter (1882-1948). Parker, D. E., et al., *Proc. Ent. Soc. Wash.* 51:84-85, 1949.
- COLLINSON, Peter (1694-1768). Rose, H. J., *New Gen. Biog. Dict.* 6:411-412, 1850; Harper, F., *Trans. Amer. Philos. Soc.* 33 (1-2), 1942-43; Brett-James, N. G., *P., Life of Peter Collinson*, Lond. 287 pp., 1926.
- COLUMELLA, Lucius Junius Moderatus (5 B.C.-54 A.D.). Rose, H. J., *New Gen. Biog. Dict.* 6:422, 1850; Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:75-76, 1919.
- COMAS, Jaime Nonell (1876-1938). Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 8:212, 1941.
- COMPARETTI, Andrea (1746-1801). Rose, *New Gen. Biog. Dict.* 6:429, 1850.
- COMPÈRE, George (1858-1928). A., P., *Arixus Escola Sup. Agr. (Barcelona)* n. s. 1:293-299, 1935.
- COMSTOCK, Anna Botsford (1854-1930). A., *Ithaca Journ.* July 10, 1945; A., P., *Cornell Rural School Leaf* 38(1):43-44, 1944; Needham, J. G., P., *Scientific Monthly* 62:140-150, 219-229, 1946.
- COMSTOCK, John Henry (1849-1931). A., *Ithaca Journ.* July 10, 1945; A., P., *Cornell Rural School Leaf* 38(1):30-31, 1944; Needham, J. G., P., *Scientific Monthly* 62:140-150, 219-229, 1946; Bonnet, P., P., *Bibliographia Araneorum* 1:46, 1945.
- CONDE, Otto (1905-1944). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 11:141, 1944.
- CONNOLD, Edward Thomas (-1909). Kuhnt, P., *Deutsche Ent. Ztschr.* p. 330, 1910; A., P., *Hastings & E. Sussex Nat.* 1:197-199, 1910.
- CONSTANT, Alexandre (1829-1901). A., *Ent. Record* 12:218, 1901; Fowler, W. W., *Trans. Ent. Soc. Lond. (Proc.)*:xxxv, 1901.
- COOK, Frank Cummings (1877-1923). A., *Semi-Weekly Farm News (Dallas, Tex.)*, June 26, 1923.
- COOKE, Benjamin (1816-1883). A., *Ent. Mo. Mag.* 19:238, 1883.
- COOKE, Caleb (1838-1880). A., *Psyche* 3:1-7, 1880.
- COOKE, Nicholas (1818-1885). Carrington, J. T., *Entomologist* 18:175-176, 1885.
- COOKE, Thomas (1814-1885). A., *Psyche* 5:35, 1888; A., *Entomologist* 18:200, 1885.
- COOLING, Lancelot E. (1893-1924). Bryan, W. H., *Proc. Roy. Soc. Queensland* 37:1-2, 1925; Musgrave, A., B., *Bibliog. Austr.* Ent. p. 55, 1932.
- COOPER, James (1792-1879). Carrington, J. T., *Entomologist* 12:280, 1879.
- COOPER, James Graham (1830-1902). Essig, E. O., *Hist. of Ent.* p. 588, 1931.
- COOPER, John Anderson (1849-1896). A., *Ent. Record* 8:70, 1896; A., *Entomologist* 29:200, 1896.
- COPE, Edward Drinker (1840-1897). A., *Natural Science (Lond.)* 10:353, 1897; Woodward, A. S., B., *Natural Science (Lond.)* 10:377-381, 1897; Osborn, H. F., B., P., *Nat. Acad. Sci. Biog. Mem.* 13:125-317, 1931.
- COPELLO, Andrés (-1948). A., B., *Rev. Soc. Ent. Arg.* 14:233-234, 1949.
- COQUILLET, Daniel William (1856-1911). A., P., *Arixus Escola Sup. Agr. (Barcelona)*, n. s. 1:497-499, 1934-35.
- CORBET, Alexander Steven (-1948). Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (C)* 13:67, 1948-49.
- CORBETT, Herbert Henry (1856-1921). "E. G. B." P., *Naturalist (Lond.)* pp. 145-149, 1921.
- CORSINI, Tommaso (-1919(?)). Verity, R., *Bul. Soc. Ent. Ital.* 51:73-75, 1919.
- CORTÉS, Jerónimo (-). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:77-78, 1919.
- COSTA, Achille (1823-1898). Della Valle, A., *Atti Accad. Pontaniana (Napoli)*, 29: Necrologia 4, 6 pp., 1899.
- COSTA, Oronzio Gabriele (1787-1867). A., *Ent. Mo. Mag.* 4:236, 1868; Sanctis, L. de Ann. Accad. Aspir. Nat. (2) 1:17-28, 1868; Guiscardi, G., *Rend. Accad. Sci. Fis. e Nat. (Napoli)* 6:373-374, 1867.
- COUCKE, Louis (-1895). Lameere, A., *Ann. Soc. Ent. Belg.* 39:415-416, 1895.
- COURVOISIER, Ludwig Georg (1843-1918). Von der Goltz, *Ent. Rundschau* 36:31, 35-36, 1919; "B.", *Ent. Zeitschrift (Frankfurt)* 49:113-114, 1935; Beuret, H., *Arch. Insektenk. Oberheingeb.* 1:196-197, 1925.
- COX, W. E. (-1948). Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (C)* 13:67, 1948-49.

- CRAW, Alexander (1850-1908). A., Ent. Rundschau 26:10, 1909; Kotinsky, J., P., Rpt. Bd. Comm. Agr. & Forestry (Haw.) 5:v-vii, 1909.
- CRAWFORD, William Monod (1872-1941). "G. W.," P., Irish Nat. Journ. 7:336-337, 1941.
- CRESSON, Ezra Townsend, Jr. (1876-1949). Calvert, P. P., B., P., Ent. News 60:85-99, 1949.
- CREWE, H. Harpur (-1883). A., Ent. Mo. Mag. 20:118-119, 1883.
- CROISSANDEAU, Jules (1843-1895). Barthe, E., Miscellanea Ent. 3:1, 1895; Mesmin, L., P., l. c. 3:47-48, 1895; A., Insekten-Börse 12:91, 1895; Ragonot, E. L., Ann. Soc. Ent. France 64 (Bull.):ccxx, 1895.
- CROSBY, Cyrus Richard (1879-1937). Johannsen, O. A., Proc. N. Y. State Hort. Soc. 82nd Ann. Meet.:281-282, 1937; Bishop, S. C., P., Festschrift Embrik Strand 4:661-662, 1938; Bonnet, P., P., Bibliographia Araneorum 1:57-58, 1945; Osborn, H., P., Fragments Ent. Hist. 2:66-77, 1946.
- CROSS, Howard Benjamin (1889-1921). A., Amer. Journ. Trop. Med. 2:177, 1922.
- CROTCH, George Robert (1842-1874). Saunders, S. S., Trans. Ent. Soc. Lond. (Proc.):xxxvi, 1874.
- CROTCH, William Duppa (-1903). A., Ent. Mo. Mag. 39:256, 1903.
- CRUTTWELL, Charles Thomas (1847-1911). Dixey, F. A., Ent. Record 23:183-184, 1911; Fowler, W. W., Ent. Mo. Mag. 47:114, 1911; Morice, F. D., Trans. Ent. Soc. Lond. (Proc.):cxxxii, 1912.
- CRUZ, José da Costa (1894-1940). Pacheco, G., B., P., Mem. Inst. Oswaldo Cruz 36:xxv-xxxi, 1941.
- CRUZ, OSWALDO Gonçalves (1872-1917). A., Physis 3:307-308, 1917; Howard, L. O., P., Pop. Sci. Monthly 87:169, 1915; A., P., Mem. Inst. Oswaldo Cruz 15:5-37, 1922.
- CUISINE, Henry de la (-1891). Grouvelle, A., Ann. Soc. Ent. France (Bull.):c, 1891; Boucard, A., The Hummingbird 1:57, 1891.
- CUNI Y MARTORELL, Miguel (1827-1902). Mir y Navarro, M., Mem. R. Acad. Cienc. y Artes Barcelona (3) 7: 511-521, 1909; Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:188, 1919; Navás, L., P., Bol. Soc. Aragonesa Cienc. Nat. 1:114-121, 1902.
- CURTIS, John (1791-1862). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 125 (footnote), 1874.
- CURTIS, John L. (-1897). Kellogg, V. L., Ent. News 8:75, 1897.
- CURTIS, William (1746-1799). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 125, 1874.
- CUVIER, George Léopold Chrétien Frédéric Dagobert (1769-1832). Eiseit, J. N., Geschichte, Systematik und Literatur der Insektenkunde pp. 75-76, 1836; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 121-125, 1874; Burckhardt, R., Zool. Annalen 3:69-77, 1910; Rose, H. J., New Gen. Biog. Dict. 6:511-512, 1850; Mestre, A., Mem. Soc. Cubana Hist. Nat. 3:39-44, 1917.
- CZEKLIS, Daniel (1857-1938). Weindel, V., P., Verh. & Mitt. Siebenburg. Ver Naturw. zu Hermannstadt 85-86, 1-11, 1935-36; Weindel, V., B., l. c., 87-88, 1-5, 1937-38.
- CZENPINSKY, Paulus de (-). Eiseit, J. N., Geschichte, Systematik und Literatur der Insektenkunde p. 53, 1836.
- CZESCHKA, Fritz (1857-1910). Kuhn, P., Deutsche Ent. Ztschr. pp. 715-716, 1910.
- CZIZEK, Karl (1871-1925). Landrock, K., Konowia 5:70-71, 1926.
- DADANT, Camille Pierre (1851-1938). A., L'Abeille e l'Erable (2) 7 (4):43-44, 1938; A., Amer. Bee Journ. 78:151, 1938.
- DAHL, Eric (1887-1944). Klefbeck, E., Ent. Tidskrift 65:214, 1944.
- DAHL, Friedrich Theodor (1856-1929). Korschelt, E., Zool. Anzeiger 84:206, 1929; Bischoff, H., B., P., Mitt. Zool. Mus. Berlin 15:625-632, 1930; Bonnet, P., P., Bibliographia Araneorum p. 50, 1945.
- DAHLBOM, Anders Gustav (1806-1859). Schaum, H. R., Berliner Ent. Ztschr. 4:104, 1860; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 125-127, 1874.
- DAHLSTRÖM, Julius (1834-1907). Aigner, L., P., Rovartani Lapok (Budapest) 14:183-185; (German summary) 14:(9-10):13, 1907.

- DAKIN, John A. (-1900). Calvert, P. P., Ent. News 11:451, 1900.
- DALE, Charles William (1851-1906). Banks, E. R., Ent. Mo. Mag. 42:91-92, 1906; A., Ent. Record 18:82-83, 1906; Merrifield, F., Trans. Ent. Soc. Lond. (Proc.):xciv, 1906.
- DALE, Edward Robert (-1903). Dale, C. W., Ent. Mo. Mag. 39:255-256, 1903; Poulton, E. B., Trans. Ent. Soc. Lond. (Proc.):lxxvii, 1903.
- DALE, James Charles (1792-1872). A., Ent. Mo. Mag. 8:255-256, 1872; Westwood, J. O., Trans. Ent. Soc. Lond. (Proc.):L, 1872.
- DALE, Samuel (1659-1739). Rose, H. J., New Gen. Biog. Dict. 7:3, 1850.
- DALLA-TORRE, Karl Wilhelm von (1850-1928). Strand, E., Internat. Ent. Ztschr. 22:337-340, 1929.
- DALLAS, Ernesto D. (1885-1943). Lizer y Trelles, C. A., Curso de Entomologia 1:48, 1947.
- DALMAS, Raymond de (1862-1930). Bonnet, P., P., Bibliographia Araneorum p. 52, 1945.
- DALTRY, Thomas William (1832-1904). Bladen, W. W., B., P., Ann. Rpt. & Trans. North Staffordshire Field Club 39:37-48, 1904-05.
- DAMIN, Narcis (1845-1905). Bonnet, P., P., Bibliographia Araneorum p. 43, 1945.
- DAMPF, Alfonso (1884-1948). Alexander, C. P., Ent. News 59:89-91, 1948; Borgmeier, T., P., Rev. Ent. (Brasil) 19:588-589, 1948; Williams, C. B., Proc. Roy. Ent. Soc. Lond. (C) 13:67, 1948-49; "J. L.," Rev. Soc. Ent. Arg. 14:231-233, 1949.
- DAMPIER, William (1652-1715). Rose, H. J., New Gen. Biog. Dict. 7:12-13, 1850; von Hagen, V. W., Green World of the Naturalist pp. 97-105, 1948.
- DANFORTH, Stuart T. (1900-1938). Wolcott, G. N., Science 89:169-170, 1939; Wetmore, A., P., Journ. Agr. Univ. Puerto Rico 23:1-5, 1939; Osborn, H., Fragments Ent. Hist. 2:77, 1946.
- DANIEL, Karl (-1930). Heikertinger, F., Koleopt. Rundschau 16:33, 1930-1931.
- DARLING, Samuel Taylor (1872-1925). Hegner, J., P., Parasitology 12:117-119, 1926; A., P., Amer. Journ. Trop. Med. 5:319-321, 1925.
- DARWIN, Charles Robert (1809-1882). A., Ent. Mo. Mag. 18:278-279, 1882; Stainton, H. T., Trans. Ent. Soc. Lond. (Proc.):xxxiii-xlix, 1882; Packard, A. S., Jr., et al., American Nat. 16:487-490, 1882; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 130-134, 1874; Linder, C., Bull. Soc. Vaudoise Sci. Nat. 45:345-352, 1909; Weismann, A., Smithsonian Rpt. for 1909, pp. 431-452, 1910; Schiller, W., B., Rev. Mus. La Plata 33:299-325, 1932; Shaver, J. M., Journ. Tenn. Acad. Sci. 17:351-359, 1942; von Hagen, V. W., Green World of the Naturalists pp. 167-181, 1948; Bryce, J., et al., P., Proc. Amer. Philos. Soc. 48:iii-lvii, 1909; Hadley, T., et al., Psychological Review 16:143-218, 1909.
- DARWIN, Erasmus (1731-1802). Weiss, H. B., Ent. News 38:106-11, 1927; Rose, H. J., New Gen. Biog. Dict. 7:23-24, 1850.
- DASHWOOD-JONES, William Arthur (1858-1928). Green, G. M., P., Proc. Ent. Soc. Br. Columbia 43:41-43, 1947.
- DAVALL, Edmund (1793-1860). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 136-137, 1874.
- DAVID, Armand (1826-1900). Giard, A., Bull. Soc. Ent. France pp. 325-326, 1900.
- DAVIDSON, James (1885-1945). A., P., Journ. Austr. Inst. Agr. Sci. 11:151-152, 1945; Andrewartha, H. G., B., P., Trans. Roy. Soc. So. Austr. 69:313-317, 1943.
- DAVIES, Edwin C. H. (-1909). "C. M.," Entomologist 42:168, 1909.
- DAVIS, Alonzo Clayton (1901-1942). Osborn, H., Fragments Ent. Hist. 2:77, 1946.
- DAVIS, Edward Mott (1888-1943). Florida Nat. 17:51-52, 1944.
- DAVIS, Harrold Fosbery Consett (-1944). Browne, W. R., Proc. Linn. Soc. N. S. Wales 70:ii, 1945.
- DAVIS, Nelson Caryl (1892-1933). A., Journ. Parasitology 20:95-96, 1934.
- DAVIS, William Thompson (1862-1945). Weiss, H. B., P., Journ. N. Y. Ent. Soc. 53:127-135, 1945; Teale, E. W., et al., P., Bull. Bklyn. Ent. Soc. 40:1-6, 1945; A., N. Y. Times, p. 19, 1945; Wade, J. S., et al., P., Proc. Ent. Soc. Wash. 47:230-235, 1945; Wade, J. S., Ann. Ent. Soc. Amer. 39:343-344, 1946; Teale, E. W., P., Near Horizons, Chapt. 13:127-136, 1942; Abbott, M., P., Staten I. Historian 7:17-18, 1944; de la Torre-Bueno, J. R., et al., P., Bull. Bklyn. Ent.

- Soc. 37:117-140, 1942; A., P., Mus. Bull. Staten Is. Inst. Arts & Sci. 25(1):2-3, 1942; Abbott, M., Life of William T. Davis, Cornell Univ. Press 336 pp., 1949.
- DAWSETT, A. (-1896). A., Ent. News 8:72, 1897.
- DAWSON, John (-1879). Dunning, J. W., Trans. Ent. Soc. Lond. (Proc.):lix, 1879.
- DECAUX, François (-1899). Bouvier, E. L., Bull. Soc. Ent. France p. 285, 1899.
- DÉFAGO, Gérard (1906-1942). Mariétan, I., B., P., Verh. Schweiz. Naturf. Ges. 122:290-291, 1942.
- DEGEER, Carl (1720-1778). Rose, H. J., New Gen. Biog. Dict. 7:496, 1850; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 143-144, 1874; Bonnet, P., Bibliographia Araneorum p. 29, 1945.
- DEINBOLL, Peter Vogelius (1783-1874). Hagen, H., Stettiner Ent. Zeit. 5:69, 1844; Skilling Magazin 71:148-154, 162-164, 293-299, 306-308; 72:430-434, 1883; Werner, J., Nyt Mag. f. Naturv. 55:197-208, 1917; Strand, E., Nyt Mag. f. Naturv. 56:129-130, 1919; Henriksen, K. L., Ent. Meddelelser 15:78, 1922; Natvig, L. R., Norsk Ent. Tidsskrift 6:114-123, 1942; Natvig, L. R., P., l. c. 7:10-13, 1944.
- DEJEAN, Pierre François Marie Auguste (1780-1845). Marseul, S. de, B. only L'Abeille, 21 (Les Ent. et leurs Écrits):61-63, 1883; Arnett, R. H., Jr., Coleopterists' Bull. 2:15-16, 1948.
- DELÉTANG, Luis Francisco Alejandro (1882-1931). A., Physis (Arg.) 11:190-192, 1932; Lizer y Trelles, C. A., Curso de Entomologia 1:46-47, 1947.
- DELPINO, Giacomo Guiseppe Federico (1833-1905). Brunelli, G., Boll. del Naturalista (Siena) 25:49-50, 1905; Ludwig, F., Naturw. Rundschau 20:412-415, 1905.
- DEMUTH, George S. (1871-1934). A., P., Outdoor Indiana 1(4):18, 1934.
- DENIER, Pedro Celestino Luis (1892-1941). Lizer y Trelles, C. A., Curso de Entomologia 1:49, 1947.
- DENIS, Michael (1729-1800). Eiselt, J. N., Geschichte, Systematik und Literatur der Insektenkunde p. 52, 1836; Rose, H. J., New Gen. Biog. Dict. 7:57, 1850.
- DENNIS, A. W. (-1946). Jackson, R. A., P., Proc. & Trans. So. Lond. Ent. & N. H. Soc. p. 56, 1946-47.
- DENNIS, George Christopher (1848-1897). Porritt, G. T., Ent. Mo. Mag. 34:44, 1898; A., Ent. Record 10:24, 1898; Porritt, G. T., P., Naturalist (Lond.) pp. 113-114, 1898.
- DEPLANCHE, Émile (1824-1875). Vieillard, E., Bull. Soc. Linn. Normandie (2) 10:341-350, 1876.
- DERENNE-MEYERS, Franz (1873-1941). Bentinck, G. A., Ent. Berichten 11:17-18, 1942; Berger, L., Lambillionea 44:3-4, 1944; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:206, 1942.
- DERHAM, William (1657-1735). Rose, H. J., New Gen. Biog. Dict. 7:61-62, 1850.
- DESHPANDE, V. G. (-1941). A., Indian Journ. Ent. 3:351, 1941.
- DESLANDES, Andrew Francis Boureau (1690-1757). Rose, H. J., New Gen. Biog. Dict. 7:68, 1850.
- DEVILLE, Jean Sainte-Claire (1870-1932). Barthe, E., B., P., Miscellanea Ent. 36:66-71, 74-79, 1935; Munster, T. Norsk Ent. Tidsskrift 3:147, 1932.
- DEYROLLE, Achille (1813-1865). Pascoe, F. P., Trans. Ent. Soc. Lond. (3) 2 (Journ. of Proc.):139, 1864-66.
- DIETZE, Karl (1851-1935). Heller, K. M., B., P., Iris 49:190-194, 1935.
- DILLENIUS (Dillen), Joannes Jacobus (1687-1747). Rose, H. J., New Gen. Biog. Dict. 7:82-83, 1850.
- DITTRICH, Rudolf (1850-1922). Pax, F., Deutsche Ent. Ztschr. pp. 94-97, 1923; Wolf, P., Jahresh. Ver. Schles. Insektenk. Breslau 14:21-23, 1924.
- DIXON, Roland Maurice (1858-1910). Dixon, J., Zoologist 69:118-119, 1911.
- DOANE, Rennie Wilbur (1871-1942). Osborn, H., Fragment Ent. Hist. 2:77-78, 1946.
- DOBRÉE, Nicholas Frank (1831-1908). Porritt, G. T., B., P., Naturalist (Lond.) pp. 48-50, 1908.
- DOBSON, George Edward (-1895). A., Irish Nat. 5:73, 1896.
- DOBSON, H. T. (-1914). A., Ent. Record 26:208, 1914.
- DOEDERLEIN, Ludwig (1855-1936). A., Zool. Anzeiger 114:160, 1936.
- DOELLO JURADO, Martin (-1948). A., Rev. Soc. Ent. Arg. 14:234-238, 1949.

- DÖNITZ, Wilhelm (1838-1912). Knoblauch, A., Ber. Senckenberg. Naturf. Ges. 43:293-294, 1912.
- DOHERTY, William (1857-1901). Holland, W. J., Ent. News 13:63-64, 1902.
- DOHRN, Carl August (1806-1892). A., Leopoldina 28:109, 1892; Frankenstein, A., et al., P., Insekten-Börse 9 (11):unnumbered, 1892; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 149-154, 1874; Boucard, A., The Hummingbird 2:135, 1892.
- DOHRN, Felix Anton (1840-1909). A., Zool. Anzeiger 35:96, 1909; Boveri, T., et al., P., Die Naturwissenschaften 28:785-816, 1940; A., Ent. Rundschau 26:120, 1909; Winter, F. W., Ber. Senckenberg. Naturf. Ges. 41:142-151, 1910.
- DOHRN, Heinrich (1838-1913). Burr, M., P., Ent. Record 26:192, 1914.
- DOKHTOUROFF, Vladimir Serghyeevich (1859-1890). "F.," Krancher's Ent. Jahrbuch pp. 195-196, 1892.
- DOLESCHALL, C. Ludwig (1827-1859). Redtenbacher, L., Verh. Zool. Bot. Ges. Wien 12:801-808, 1862; Bonnet, P., Bibliographia Araneorum 1:35, 1945.
- DOMBEY, Joseph (1742-1796). Rose, H. J., New Gen. Biog. Dict. 7:105, 1850.
- DOMINIQUE, Jules (1838-1902). Bureau, L., B., P., Bull. Soc. Sci. Nat. Ouest France (2) 3:471-491, 1903.
- DONZEL, Hugues Fleury (1791-1850). Mulsant, E., B., Opuscles Ent. 2:155-172, 1853.
- DORIA, Giacomo (1840-1913). Gestro, R., B., P., Ann. Mus. Civ. Stor. Nat. Genova 50:1-78, 629-632, 1921-26.
- DORMER, John Baptiste Joseph (1830-1900). A., Ent. Mo. Mag. 37:49, 1901.
- DORVILLE, Henry (1798-1874). "J. H.," Ent. Mo. Mag. 11:160-161, 1874.
- DOS PASSOS, Violet (1891-1944). Comstock, W. P., Journ. N. Y. Ent. Soc. 53:47-48, 1945.
- DOTREPPE, Auguste Joseph (-1944). Berger, L., Lambillionea 44:4, 1944.
- DOUBLIER, Jean Theodore (1814-1854). Mulsant, E., Opuscles Ent. 7:175-186, 1856; Mulsant, E., Ann. Soc. Linn. Lyon (n. s.) 3:175-186, 1856.
- DOUGLAS, Benjamin Wallace (1882-1939). A., P., Outdoor Indiana 11(10):4, 16, 1944.
- DOUGLAS, John William (1814-1905). Merrifield, F., Trans. Ent. Soc. Lond. (Proc.):lxxxv-lxxxvi, 1905; Dale, C. W., Ent. Mo. Mag. 42:16, 1906.
- DOURS, Jean Antoine (1824-1874). Saunders, S. S., Trans. Ent. Soc. Lond. (Proc.):lxxxvii, 1874.
- DOUS, Carl Philip Emil le (1866-1936). Henriksen, K., L., P., Ent. Meddelelser 20:102-103, 1938.
- DOUSETT, Arthur (-1896). Meldola, R., Trans. Ent. Soc. Lond. (Proc.):xciv, 1896; A., Ent. Mo. Mag. 33:19-20, 1897.
- DOWELL, Philip (1864-1936). Osborn, H., Fragments Ent. Hist. 2:78, 1946.
- DRAPARNAUD, Jacques Philippe Raymond (1772-1805). Rose, H. J., New Gen. Biog. Dict. 7:138, 1850.
- DRESCHER, Rudolf (-1935). A., Arb. Morph. Taxon. Ent. Berlin-Dahlem 3:151, 1936.
- DRESNAY, G. du (-). Lucas, D., L'Entomologiste 2:196-197, 1946.
- DREWSSEN, Christian (1799-1896). Engelhart, C., Ent. Meddelelser 12:18, 1918.
- DRYANDER, Jonas (1748-1810). Rose, H. J., New Gen. Biog. Dict. 7:146-147, 1850.
- DUBINI, Angelo (1813-1902). Giovannola, A., P., Riv. di Parassitologia 3:1-4, 1939.
- DUBOURGAI, A. (-). Fauvel, A., Rev. d'Ent. 25:28, 1906.
- DUCHON, Emanuel (1865-1944). Heyrovsky, L., P., Acta Soc. Ent. Cechosl. 42:87-88, 1945.
- DUDA, Oswald (1869-1941). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:65, 1942; Hellén, W., Notulae Ent. 23:60, 1943.
- DUFOUR, Léon Jean Marie (1780-1865). Bonnet, P., P., Bibliographia Araneorum p. 32, 1945.
- DUGES, Alfredo Augusto Delsescautz (1826-1910). del Campo, R. W., B., P., Anal. Inst. Biol. (Mex.) 8:437-455, 1937.
- DUHAMEL DU MONCEAU, Henry Louis (1700-1782). Rose, H. J., New Gen. Biog. Dict. 8:191, 1850; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 154-156, 1874.

- DUMERIL, André Marie Constant (1774-1860). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* pp. 80-85, 1836.
- DUNN, George W. (1814-1905). Essig, E. O., *P.*, *Hist. of Ent.* p. 605, 1931.
- DUNNING, Joseph William (1833-1897). Goss, H., *Naturalist (Lond.)* pp. 11-12, 1897.
- DURRANT, John Hartley (1863-1928). "W. H. T. T.," *Nature* 121:214-215, 1928.
- DUTROCHET, René Joachim Henri (1776-1847). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 158-160, 1874.
- DUTTON, James Fairclough (1859-1937). *A.*, *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 5:186, 1938.
- DUURLOO, Hans Peter (1860-1941). Kryger, J. P., *P.*, *Ent. Meddelelser* 22:274-275, 1942; Henriksen, K. L., *B.*, *Ent. Meddelelser* 15:413, 1936.
- DWINELLE, Charles Hascall (1847-). Essig, E. O., *P.*, *Hist. of Ent.* pp. 605-608, 1931.
- DYAR, Harrison Gray (1866-1929). *A.*, *Lepidopterists' News* 1:30, 1947.
- DZIERZON, Johannes (1811-1906). Pellett, K. L., *P.*, *Amer. Bee Journ.* 69:398-400, 1929; Kanden, C., *P.*, *L'Apiculteur* 21:176-178, 1877; *A.*, *P.*, *L'Apicoltore* 10:15-17, 1877.
- DZIURZYNSKI, Clemens (-1934). Reisser, H., et al., *Ztschr. Oesterr. Ent.-Ver.* 20:1-2, 1935.
- ECKSTEIN, Karl (1859-1939). *A.*, *Ent. Blätter* 35:148, 1939; Heikertinger, F., *Koleopt. Rundschau* 25:206, 1939; Tredl, A., & Kleine, R., *B.* only, *Übersicht Gesamt-literatur der Borkenkäfer 1758-1910* pp. 21-22, 1911.
- ÉCOFFET, Antoine Louis Eugène François (1795-1866). Mulsant, E., *Ann. Soc. Linn. Lyon* n. s. 20:191-193, 1873; Mulsant, E., *Opuscles Ent.* 16:55-57, 1875.
- EDGREN, Per Adolf (1802-1891). Sandahl, O. T., *Ent. Tidskrift* 12:233-236, 1891.
- EDMONDS, Thomas Herbert (1887-1944). Donisthorpe, H., *B.*, *Ent. Mo. Mag.* 80:162, 1944.
- EDWARDS, Alphonse Milne (1835-1900). Giard, A., *Bull. Soc. Ent. France* pp. 177-178, 1900; Bouvier, E. L., *P.*, *Ann. Sci. Nat. (Zool.)* 17 (Vol. du Cent.):5-6, 1934.
- EDWARDS, Edwin Hugh (1867-1939). Osborn, H., *P.*, *Fragments Ent. Hist.* 2:78, 1946.
- EDWARDS, Frederick Wallace (1888-1940). Riley, N. D., *Nature* 146:739-740, 1940; *A.*, *Indian Journ. Ent.* 3:149, 1941; *A.*, *Journ. Soc. Bibl. Nat. Hist.* 2:19-34, 1945; Imms, A. D., *P.*, *Obit. Notices Fellows Roy. Soc. (Lond.)* 3:735-745, 1941; Porter, C. E., *P.*, *Rev. Chilena Hist. Nat.* 44:386-387, 1940; Hobby, B. M., *Journ. Soc. Br. Ent.* 2:122-123, 1941; Alexander, C. P., *Records Indian Mus.* 44:31-32, 1942; Thienemann, A., *Archiv f. Hydrobiol.* 38:480, 1941.
- EDWARDS, George (1694-1773). Rose, H. J., *New Gen. Biog. Dict.* 7:211, 1850.
- EDWARDS, Henri Milne (1800-1885). Bouvier, E. L., *P.*, *Ann. Sci. Nat. (Zool.)* 17 (Vol. du Cent.):3-4, 1934.
- EDWARDS, Henry (1830-1891). *A.*, *Ent. Mo. Mag.* 27:226, 1891; Beutenmüller, W., *Ent. Record* 2:143-144, 1891; Godman, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:li-lii, 1891; Wade, J. S., *Scientific Monthly* 30:240-250, 1930; Beutenmüller, W., *The Hummingbird* 1:74, 1891; Remington, J. E., *P.*, *Lepidopterists' News* 2:7, 1948.
- EDWARDS, William Henry (1822-1909). *A.*, *Ent. Mo. Mag.* 45:190, 1909; *A.*, *Ent. Record* 21:193-194, 1909; Clench, H. K., *Lepidopterists' News* 1:8, 1947; *P.* only, *I. c.*, 2:54, 1948; dos Passos, C. F., *I. c.* 3:61-62, 1949; *A.*, *P.*, *Ent. Rundschau* 26:81, 94, 127, 1909; Horn, W., *Deutsche Ent. Ztschr.* pp. 582-583, 1909.
- EEDLE, Thomas (1829-1888). Carrington, J. T., *Entomologist* 22:52, 1889.
- EGGERS, Hans (1873-1947). Schedl, K. E., *Zentralbl. Gesamtgebiet Ent.* 3:2 pp. (un-numbered), 1949; Schedl, K. E., *B.* only, *I. c.* 1:127-128, 1946.
- EHRENBERG, Christian Gottfried (1795-1876). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 160-165, 1874.
- EHRENREICH, Paul (-1914). Kuhnt, P., *Deutsche Ent. Ztschr.* p. 357, 1914.
- EHRET, Georg Dionysius (1710-1770). Rose, New Gen. Biog. Dict. 7:217, 1850.
- EHRHORN, Edward MacFarlane (1862-1941). Osborn, H., *Fragments Ent. Hist.* 2:78-79, 1946.
- EICHOFF, Wilhelm Josef (1824-1893). Mik, J., *Wiener Ent. Zeit.* 13:80, 1894; *A.*,

- Insekten-Börse 11:23, 1894; Barthe, E., *Miscellanea Ent.* 2:107, 1894; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 44, 1874.
- EIDMANN, Hermann A. (-1949). Brown, W. L., Jr., *Ent. News* 60:262, 1949.
- EIFFINGER, Georg (1838-1920). "K. D.," *Ent. Rundschau* 37:13, 1920; Pfaff, A., et al., *Festschr. 50 Jahr. Bestehen Internat. Ent. Ver. Frankfurt* p. 7, 1934.
- EIGEN, Peter (-1948). Horion, A., *Koleopt. Zeitschrift* 1:78, 1949.
- EIMER, Theodor (1843-1898). Salzner, A., *Insekten-Börse* 15:157-158, 1898; "M. & L.," *Biol. Centralbl.* 18:721-725, 1898; Klunzinger, C. B., *B., P., Jahresh. Ver. Vaterl. Naturk. Württemberg* 55:1-22, 1899; Carrington, J. T., *Natural Science (Lond.)* 14:164-165, 1899.
- EISEN, Gustavus August (1847-1940). A., *Ent. News* 51:300, 1940; Cattell, J. M., *Amer. Men of Sci.* p. 322, 1930; Osborn, H., *P., Fragments Ent. Hist.* 2:79, 1946.
- EKWALL, Nils Arvid (1919-1942). Hanson, B. H., *Ent. Tidskrift* 64:204, 1943.
- ELLIOTT, D. C. (1909-1943). Vige, L., *Ann. Ent. Soc. Amer.* 38:140-141, 1945.
- ELLIS, John (1710-1776). Rose, H. J., *New Gen. Biog. Dict.* 7:227, 1850.
- ELLISON, George (1862-1941). Ellison, N. F., *P., Northwestern Nat.* 19:23-26, 1944.
- ELLISOR, Lewis Owen (1910-1939). Osborn, H., *P., Fragments Ent. Hist.* 2:79-80, 1946.
- ELSTER, George Rudolph (1897-1940). Osborn, H., *Fragments Ent. Hist.* 2:80, 1946.
- ELTRINGHAM, Harry (1873-1941). Carpenter, G. D. H., *B., P., Obit. Notices Fellows Roy. Soc. (Lond.)* 4:113-128, 1942; Riley, N. D., *P., Entomologist* 75:25-27, 1942; Carpenter, G. D. H., *Nature* 149:72, 1942.
- ELWES, Henry John (1846-1922). "A. H.," *Proc. Roy. Soc. Lond.* 95:xlvi-lxiii, 1923-24; Riley, N. D., *Proc. So. Lond. Ent. & N. H. Soc.* p. 76, 1923-24.
- ELY, Charles Russell (1870-1939). Osborn, H., *P., Fragments Ent. Hist.* 2:80, 1946.
- EMERTON, James Henry (1847-1930). Bonnet, P., *P., Bibliographia Araneorum* p. 46, 1945.
- EMERY, Carlo (1848-1925). Gestro, R., *B., P., Ann. Mus. Stor. Nat. Genova* 52:149-155, 1925-28; A., *Ent. Mo. Mag.* 61:209, 1925; Ghigi, A., *B., P., Riv. di Biol. (Rome)* 7:711-739, 1925.
- ENGEL, Erich Otto (1866-1944). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 11:57, 1944; Lindner, E., *P., Mitt. Münch. Ent. Ges.* 34:1-4, 1944.
- ENGELHARDT, George Paul (1871-1942). Gunder, J. D., *P., Ent. News* 41:13, 1930; Tanner, V. M., *B. of Utah, Great Basin Nat.* 3:57-58, 1942; Torre-Bueno, J. R. de la, *Ann. Ent. Soc. Amer.* 36:151, 1943; Osborn, H., *P., Fragments Ent. Hist.* 2:80-81, 1946.
- ENGLISH, James Lake (1820-1888). Carrington, J. T., *Entomologist* 21:72, 1888.
- EPPELSHEIM, Eduard (1837-1896). A., *Insekten-Börse* 13:165, 1896.
- EPPELSHEIM, Friedrich (-1899). Hering, E., *Stettiner Ent. Zeit.* 60:356-357, 1899.
- ERCOLANI, Giovanni Battista (1817-1883). Piana, G. P., *B., P., Archives Parasitol.* 5:504-550, 1902; *P., Bull. Sci. Med. Bologna* (6) 12(4-5):i-vii, 1883; A., *Journ. Comp. Med. & Surg.* 6:297-307, 1885.
- ERICHSON, Wilhelm Ferdinand (1809-1849). Marseul, S. A. de, *B. only, L'Abeille* 20 Les Ent. et leurs Ecrits:43-45, 1882; Dohrn, C. A., *P., Stettiner Ent. Zeit.* 17:61-62, 1856; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 165-167, 1874.
- ERICSON, Isaac Birger (1847-1920). Uyttenboogaart, D. L., *Ent. Berichten* 5:329-330, 1921.
- ERLANGER, Karl von (-1904). A., *Insekten-Börse* 21:306, 1904; Pagenstecher, A., *Jahrb. Nassau. Ver. Naturk.* 58:xiii, 1905.
- ERSCH, Johann Samuel (1766-1828). Rose, H. J., *New Gen. Biog. Dict.* 7:251, 1850.
- ERYLEBEN, Johann Christian Polycarp (1744-1777). Rose, H. J., *New Gen. Biog. Dict.* 7:253-254, 1850.
- ESBEN-PETERSEN, Peter (1869-1942). Tjeder, B., *P., Opuscula Ent.* 8:144-145, 1943; Wesenberg-Lund, C., *P., Vidensk. Medd. Dansk. Naturh. Foren. Kopenh.* 106:vi-xi, 1942-43; Nielsen, P., *B., P., Ent. Meddelelser* 22:336-350, 1943; A., *P., l. c.*, 20:565-566, 1940; Krogerus, R., *Mem. Soc. Fauna Fenn.* 18: 196, 1942; Nielsen, P., et al., *Flora og Fauna* 48:33-45, 1942.
- ESCHSCHOLTZ, Johann Friedrich (1793-1831). Asmuss, H., *B., Bull. Moscou* 7:81-96,

- 1834; Marseul, S. A. de, B. only, *L'Abeille* 21 (Les Ent. et leurs Écrits):73-74, 1883.
- ESMARK, Lauritz Martin (1806-1884). *Natvig, L. R., P., Norsk Ent. Tidsskrift* 7:17-19, 1944.
- ESPER, Eugen Johann Christoph (1742-1810). Rose, H. J., *New Gen. Biog. Dict.* 7:256, 1850; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 70 (footnote), 1874.
- ETHERIDGE, Robert, Jr. (1847-1920). Dun, W. S., B., *P., Records Austr. Mus.* 15:1-27, 1926.
- ETTINGHAUSEN, Constantin von (1826-1897). Hoernes, R., B., *P., Mitt. Naturw. Ver. Steiermark* 34:79-106, 1897.
- EVANS, Samuel G. (1839-1929). Davis, P., *Proc. Indiana Acad. Sci.* 41:52-54, 1931.
- EVANS, William (1851-1922). Riley, N. D., *Proc. So. Lond. Ent. & N. H. Soc. pp.* 76-77, 1923-24; Bonnet, P., *P., Bibliographia Araneorum* p. 51, 1945.
- EVERMANN, Barton Warren (-1932). Van Duzee, E. P., *Pan-Pacific Ent.* 9:10, 1933.
- EWALD (EWALDT), Benjamin (1674-1719). Rose, H. J., *New Gen. Biog. Dict.* 7:279, 1850.
- EXQUEMELEN, Alexander Olivier (-). Mac Gillavry, D., *Ent. Berichten* 12:175-178, 1947.
- FABRE, Jean Henri (1823-1915). Koelsch, A., *Ent. Zeitschrift (Frankfurt)* 29:62-64, 1915; Lynkeus, W. W., *P., Ent. Blätter* 6:249-255, 1910; de la Torre, C., *Mem. Soc. Cubana Hist. Nat.* 1:284-286, 1915; Malaquer, S., *Butl. Inst. Catalana Hist. Nat.* 12:141-146, 1915; Künckel d'Herculais, J. P. A., *Ann. Soc. Ent. France* (6) 7 (Bull.):x-xii, 1887; Lefebvre, M., *Rev. des Questions Scientifiques (Bruxelles)* 48:543-565, 1900; Perrier, E., *Rev. Scientifiques Paris* 48(1):577-579, 1910; Lafitte, J. P., *P., La Nature* 38(1):257-259, 1910; Lynkeus, W. W., *Internat. Ent. Ztschr.* 4:146-148, 152-153, 1910; Tavernier, E., *Nat. Canadien* 37:90-94, 1910; Azara, J. M., *P., Bol. Soc. Aragon. Cienc. Nat.* 15:26-31, 1916.
- FABRICIUS, Johann Christian (1745-1808). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenkunde* pp. 55-62, 1836; Essig, E. O., *Hist. of Ent.* pp. 623-625, 1931; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 173-175, 1874; Jespersen, P. H., *P., Svenska Linné-Sällskapets Arsskrift* 29:35-56, 1946; Rose, H. J., *New Gen. Biog. Dict.* 7:291, 1850; Lizer y Trelles, C. A., *Curso de Entomologia* 1:10, 1947; Dow, R. P., *Bull. Bklyn. Ent. Soc.* 8:38, 1913; Ross, E., *Internat. Ent. Ztschr.* 27:315-316, 1933; Bonnet, P., *Bibliographia Araneorum* pp. 29-30, 1945.
- FAIRMAIRE, Leon (1820-1906). A., *Ent. Mo. Mag.* 42:141, 1906; *Insekten-Börse* 23:117, 1906; Daniel, K., *Muench. Koleopt. Ztschr.* 3:393, 1908; Horn, W., *Deutsche Ent. Ztschr.* p. 11, 1906; Lesne, P., *Bull. Soc. Ent. France* pp. 73-74, 1906.
- FALCONER, William (1862-1943). Jackson, A. R., B., *P., Northwestern Nat.* 18:330-333, 1943; Bonnet, P., *P., Bibliographia Araneorum* p. 53, 1945.
- FALCOZ, Louis (1870-1938). Roman, E., *P., Bull. Mens. Soc. Linn. Lyon* 7:277-280, 1938; A., *Miscellanea Ent.* 39:103, 1938.
- FALDERMANN, Franz (1799-1838). Marseul, S. A. de, B. *L'Abeille* 22 (Les Ent. et leurs Écrits):140, 1884.
- FALKENSTRÖM, Gustaf Adolf P. (1867-1942). Leech, H. B., *Canadian Ent.* 76:211, 1944; Lundblad, O., *P., Ent. Tidsskrift* 65:37-38, 1944; *Natvig, L. R., Norsk Ent. Tidsskrift* 6:228, 1942; Kemner, N., *P., Opuscula Ent.* 7:108-111, 1942.
- FALL, Henry Clinton (1862-1939). Osborn, H., *Fragments Ent. Hist.* 2:81-82, 1946.
- FANTHAM, Harold Benjamin (1876-1937). A., *Journ. Parasitol.* 24:91-92, 1938; A., *Nature* 140:1001, 1937; Roubaud, E., *Bull. Soc. Path. Exot.* 31:178, 1938.
- FARR, William Berry (-1890). A., *Entomologist* 23:208, 1890.
- FASSEL, Anton Heinrich (1876-1922). "N. M. K.," *Internat. Ent. Ztschr.* 16:160, 193, 1922.
- FASSNIDGE, William (1888-1949). "S. N. A. J.," *Ent. Record* 61:58-59, 1949; Hobby, B. M., *I. c.* 61:129-130, 1949. "W. P. C.," *Ent. Mo. Mag.* 85:216, 1949; "N. D. R.," *Entomologist* 82:216, 1949.
- FATIO, Victor (1838-1906). A., *Rev. Suisse Zool.* 14:frontispiece, 1906.

- FAUST, Johannes (1822-1903). *A., P.*, Insekten-Börse 20:49, 1903; Champion, G. C., Ent. Mo. Mag. 39:71-72, 1903; Daniel, K., Muench. Koleopt. Ztschr. 1:388, 1903.
- FAVARCO, L. J. (-1900). *A.*, Miscellanea Ent. 8:24, 1900.
- FEA, Leonardo (1852-1903). Gestro, A., *B., P.*, Ann. Mus. Civ. Stor. Nat. Genova 41:95-152, 1904.
- FEDRIZZI, Giacinto (-1879). *A.*, Naturae Novitates 3:47, 1879; Ambrosi, F., Bull. Soc. Veneto-Trent. Sci. Nat. (Padova) 4:161-162, 1889.
- FEDSCHENKO, Alexei Pavlovich (1844-1873). McLachlan, R., Ent. Mo. Mag. 10:141, 1873; Regel, E., *P.*, Regel's Gartenflora pp. 3-7, 1874; Hensel, A., Berliner Ent. Ztschr. 18:150, 1874.
- FEIJÓO, Benito Jerónimo (1676-1764). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:78, 1919.
- FEISTMANTEL, Rudolph (1805-1871). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 175-178, 1874.
- FELDER, Rudolph (1842-1871). Wallace, A. R., Trans. Ent. Soc. Lond. (Proc.):li-lij, 1871.
- FELT, Ephraim Porter (1868-1943). Ross, H. H., Ann. Ent. Soc. Amer. 38:141, 1945; Weiss, H. B., Science 99:52-53, 1944; Burgess, A. F., *P.*, Journ. Econ. Ent. 36:950-952, 1943; Osborn, H., Fragments Ent. Hist. 2:82-83, 1946.
- FEREDAY, Richard William (-1899). *A.*, Ent. Mo. Mag. 35:275, 1899.
- FERNALD, Charles Henry (1838-1921). Baker, H. P., et al., Mass. State Coll., Fernald Club Year Book 6:2-14, 1937.
- FERNALD, Maria E. (1839-1919). Osborn, H., Fragments Ent. Hist. 2:83-84, 1946.
- FERNOW, Bernard Eduard (1851-1923). *A.*, U. S. Dept. Agr. Official Record 2(7):5, 1923; "X," Science n. s. 57:255-256, 1923.
- FERRANT, Victor (1856-1942). Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 9:285, 1942.
- FERRARI, Johann Angelo (-1876). *A.*, Ent. Nachrichten 2:130, 1876.
- FERRARI, Pietro Mansueto (1823-1893). Gestro, R., *B., P.*, Ann. Mus. Civ. Stor. Nat. Genova 33:407-416, 1893.
- FERTÉ-SÉNÉCTÈRE, F. Thibault de la Carte (See under LA FERTÉ SÉNÉCTÈRE).
- FERTON, Charles (1856-1921). *A.*, Rev. de Zool. Agr. et Appliquée 23:99-100, 1924.
- FESTA, Enrico (1868-1939). de Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 60:(1), 1940.
- FICHT, George Augustus (1900-1941). Osborn, H., Fragments Ent. Hist. 2:84, 1946.
- FICK, Wilhelm (1872-1930). Wagner, A. C. W., Verh. Ver. Naturw. Heimatforsch. (Hamburg) 22:xx-xxi, 1930.
- FICKERT, Karl Rudolf Dietrich (1849-1904). *A.*, Insekten-Börse 21:202, 1904.
- FIELD, Herbert Haviland (1868-1921). Ward, H. B., Science 54:424-428, 1921.
- FINDAL, J. Kristian (1871-1938). Knudsen, B., *P.*, Flora og Fauna (Copenhagen) 45:1-6, 1939.
- FINGERLING, Max (1844-1904). *A., P.*, Insekten-Börse 21:121, 1904.
- FINLAY, Carlos Juan (1833-1915). de Castro, R., Rev. Med. Trop. y Parasit. Bact. Clin. y Lab. (Cuba) 7:16-20, 1941; Bloom, S., et al., *I. c.* 7:59-65, 1941; Kouri, P., et al., *P.*, *I. c.* 9:75-86, 1943; Hoffmann, W. H., *I. c.* 10:125-128, 1944; Howard, L. O., Pop. Sci. Monthly 87:173, 1915.
- FINLAY, John (1835-1897). *A.*, Ent. Record 9:270, 1897.
- FINOT, Pierre Adrien Prosper (1838-1908). Kheil, M. M., Internat. Ent. Ztschr. 5:185, 190-191, 197-199, 203-204, 213-215, 1911.
- FINTELMANN, Louis (1802(?)-). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 478 (footnote), 1874.
- FIORI, Andrea (1854-1933). *A.*, Miscellanea Ent. 35:47, 1934.
- FISCHER, August (1864-1931). Jöst, H., Ent. Zeitschrift (Frankfurt) 45:171, 1931.
- FISCHER, F. (-). Essig, E. O., Hist. of Ent. pp. 630-631, 1931.
- FISCHER, Leopold Heinrich (1817-1886). Keller, R., *B., P.*, Arch. Insektenk. Ober-rheingebietes 2:217-224, 1928.
- FISCHER-SIGWART, Hermann (1842-1925). Leuthardt, F., *P.*, Tätigkeitsber. Naturf. Ges. Baselland 7:163-171, 1922-25.
- FISCHER VON WALDHEIM, Gotthelf Friedrich (1771-1853). *A.*, Proc. Linn. Soc. Lond.

- 2:318-320, 1854; Marseul, S. A. de, B. only, L'Abeille 21 (Les Ent. et leurs Ecrits):117-120, 1883; Newman, E., Zoologist 12:4229-4230, 1854; Dohrn, C. A., Stettin. Ent. Zeit. 28:77-78, 1867.
- FISON, Albert James (1840-1912). Wheeler, G., Ent. Record 24:280, 1912.
- FITCH, Edward Arthur (1854-1912). A., Ent. Mo. Mag. 48:244, 1912; A., Ent. Record 24:228, 1912; Morley, C., Entomologist 45:235-236, 1912; Morice, F. D., Trans. Ent. Soc. Lond. (Proc.):clxv, 1912.
- FITZ, Ernst (1869-1939). Schawerda, K., P., Ztschr. Wien. Ent. Ver. 24:161-162, 1939.
- FLACH, Karl (1856-1920). Schwarzer, B., P., Ent. Blätter 16:193-194, 1920.
- FLEISCHER, Anton (1850-1934). A., Miscellanea Ent. 35:117-118, 1934; A., P., l. c. 36:7, 1935.
- FLEISCHER, Josef (1866-1940). Obenberger, J., P., Acta Soc. Ent. Cechoslov. 37:16-17, 1940.
- FLEISCHMANN, Friedrich (1874-1909). Rebel, H., Verh. Zool.-Bot. Ges. Wien 59:(240)-(241), 1909.
- FLETCHER, James (1852-1908). Howard, L. O., Science n. s. 28:916-917, 1908; A., Ent. Record 21:145-146, 1909; A., P., Ent. Rundschau 26:3, 1909; A., Deutsche Ent. Ztschr. p. 346, 1909.
- FLETCHER, John Edward (1836-1902). A., Ent. Mo. Mag. 38:134-135, 1902; Fowler, W. W., Trans. Ent. Soc. Lond. (Proc.):lviii, 1902.
- L'EURY, Arthur C. (1888-1938). A., P., Bull. Calif. Dept. Agr. 28:130-131, 1939.
- FLINT, Wesley Pillsbury (1882-1943). Osborn, H., Fragments Ent. Hist. 2:84-85, 1946.
- FLOR, Gustav von (-1883). A., Ent. Mo. Mag. 20:72, 1883; A., Ent. Nachrichten 10:60, 1884.
- FLOYD, Bayard Franklin (1882-1945). Watson, J. R., P., Florida Ent. 28:39, 41, 1945.
- FÖRSTER, Carl (1854-1923). Arndt, W., B., Jahresh. Ver. Schles. Insektenk. Breslau 14:25-27, 1924.
- FÖGELQVIST, Gustaf (1881-1946). Lindroth, C. H., Ent. Tidskrift 67:233, 1946.
- FOLOGNE, Egide (-1919). Lameere, A., Ann. Soc. Ent. Belg. 59:123-124, 1919.
- FOLSOM, Justus Watson (1871-1936). Mills, H. B., Bull. Mus. Comp. Zool. Harvard 82:231-232, 1938; Osborn, H., Fragments Ent. Hist. 2:85, 1946.
- FONTANA, Felice (1730-1805). Rose, H. J., New Gen. Biog. Dict. 7:407-408, 1850; Ambrosi, F., Bull. Soc. Veneto-Trent. Sci. Nat. (Padova) 4:145-149, 1889.
- FORBES, James (1749-1819). Rose, H. J., New Gen. Biog. Dict. 7:412, 1850.
- FORBES, Stephen Alfred (1844-1930). A., P., Scientific Monthly 30:474-476, 1930.
- FORBES, William Alexander (1855-1883). A., Ent. Mo. Mag. 20:21-22, 1883; A., Psyche 4:79, 1883.
- FORBUSH, Edward Howe (-). May, J. B., B., P., Proc. Bost. Soc. Nat. Hist. 39(2):33-72, 1928.
- FORD, A. (-1943). Turner, H. J., Ent. Record 55:70, 1943; Turner, H. J., Ent. Mo. Mag. 79:155, 1943.
- FORDHAM, William John (1882-1942). Walsh, G. B., Ent. Mo. Mag. 79:48, 1943.
- FORESTUS, Petrus (1522-1597). Rose, H. J., New Gen. Biog. Dict. 7:415, 1850.
- FORMÁNEK, Romuald (1853-1927). Fleikertinger, F., B., Koleopt. Rundschau 13:243-245, 1927; A., Wiener Ent. Zeit. 44:80, 1927.
- FORSIUS, Runar (1884-1935). "T. H. S.," Norsk Ent. Tidsskrift 4:135-136, 1936.
- FORSKAL, Pehr (1736-1763). Rose, H. J., New Gen. Biog. Dict. 7:416-417, 1850.
- FORSSELL, Nils Edvard (1821-1883). Sandahl, O. T., Ent. Tidskrift 4:97-100, 120-122, 1883.
- FÖRSTER, Johann Reinhold (1729-1798). Rose, H. J., New Gen. Biog. Dict. 7:417-418, 1850; Brockhaus, F. A., Der Grosse Brockhaus 6:397, 1930.
- FORSYTH, William (1737-1804). Rose, H. J., New Gen. Biog. Dict. 7:418, 1850.
- FORTI, Achille (1878-1937). Trotter, A., P., Marcellia 29:102-104, 1934-35 (1937).
- FORWERG, Hugo Bernhard (1835-1905). A., Insekten-Börse 22:186, 1905.
- FOUDRAS, Antoine Casimir Marguerite Eugène (1783-1859). Mulsant, E., B., P., Opuscules Ent. 11:21-42, 1859; Mulsant, E., Ann. Soc. Linn. Lyon n. s. 6:1-22, 1859.
- FOUNTAIN, Margaret Elizabeth (1862-1940). Sheldon, W. G., P., Entomologist 73:193-195, 1940.
- FOURCROY, Antoine François de (1753-1809). Cuvier, G., Eloges Historiques pp. 163-

- 200, 1835; Rose, H. J., *New Gen. Biog. Dict.* 7:426-427, 1850; Cuvier, G., *Ann. Mus. Hist. Nat. (Paris)* pp. 99-132, 1811.
- FOWLER, William Weekes (1849-1923). Donisthorpe, H., *Nature* 111:888, 1823; Riley, N. D., *Proc. So. Lond. Ent. & N. H. Soc.* p. 76, 1923-24.
- FOX, Charles Louis (1869-1928). Van Duzee, E. P., *Pan-Pacific Ent.* 4:192, 1928.
- FOX, Edward Carteret Dobree (-1906). Bankes, E. R., *Ent. Mo. Mag.* 42:141, 1906.
- FRANCHINI, Guiseppa (1879-1938). Roubaud, E., *Bull. Soc. Pathol. Exot.* 31:533-534, 1938.
- FRANCIS, William (1817-1904). A., *Proc. Linn. Soc. Lond.* 116:31, 1903-04.
- FRANCK, Paul A. R. (1874-1936). Horn, W., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 3:300, 1936; Sokolowski, K., P., *Ent. Blätter* 33:135-136, 1937.
- FRANCK VON FRANKENAU, Georg (1644-1704). Rose, H. J., *New Gen. Biog. Dict.* 7:438, 1850.
- FRANÇOIS, Philippe (1859-1908). Caullery, M., et al., B., P., *Bull. Sci. France et Belg.* 42:lxv-xciv, 1909.
- FRANK, Albert Bernhard (1839-1900). Schröder, C., P., *Illustr. Ztschr. Ent.* 5:390-391, 1900; Krüger, O., B., P., *Deutsche Landwirtschaftl. Presse* 27:998, 1900.
- FRANKLIN, Benjamin (1706-1790). Rose, H. J., *New Gen. Biog. Dict.* 7:440-442, 1850.
- FRANZIUS, Wolfgang (1564-1628). Rose, H. J., *New Gen. Biog. Dict.* 7:442, 1850.
- FREDERICI, Enrico (1901-1925). Cannezz, A., B., *Riv. di Biol. (Rome)* 7:607-609, 1925.
- FREEMAN, Francis Ford (1847-1908). A., *Ent. Record* 20:123, 1908; "A. H. J.," *Ent. Mo. Mag.* 44:114, 1908; Waterhouse, C. O., *Trans. Ent. Soc. Lond. (Proc.)*:cvi, 1908.
- FREESE, Anton (1866-1923). Meyer, H. F., *Sitzb. & Vorträge Ent. Ver. Hamburg-Altona* pp. 55-56, 1924.
- FREIGIUS (FREY), Johann Thomas (1543-1583). Rose, H. J., *New Gen. Biog. Dict.* 7:449, 1850.
- FRENCH, Charles (1840-1933). Walker, J. J., *Ent. Mo. Mag.* 69:206-207, 1933.
- FRENCH, George Hazen (1841-1935). Meiners, E. P., P., *Lepidopterists' News* 2:40, 1948.
- FRERS, Arturo German (1900-1925). Dallas, E. D., B., P., *Rev. Soc. Ent. Arg.* 2:289-292, 1929; A., *Physis (Arg.)* 7:410-412, 1925; Lizer y Trelles, C. A., *Curso de Entomologia* 1:50-51, 1947.
- FREY, Heinrich (1822-1890). Walsingham, Lord. *Trans. Ent. Soc. Lond. (Proc.)*:lviii, 1890; Rudol, F., *Festschr. Naturf. Ges. Zürich* pp. 91-93, 1896.
- FREY, Johann Thomas (See under FREIGIUS).
- FREY-GESSNER, Emile (1826-1917). Steck, T., B., *Verh. Schweiz. Naturf. Ges.* 100:99-104, 1918.
- FRIEB, Hermann (-1948). Horion, A., *Koleopt. Zeitschrift* 1:78, 1949.
- FRIEDRICH, Otto (1846-1906). A., P., *Insekten-Börse* 23:141, 1906.
- FRIOMET, Charles (-1945). Berger, L., *Lambillionea* 45:77, 1945.
- FRIPP, Henry Edward (1816-1880). A., B., P., *Proc. Bristol Nat. Soc. n. s.* 7:1-3, 1891-92.
- FRISCH, Johann Leonhard (1666-1743). Eiselt, J. N., *Geschichte, Systematik und Literature der Insecten*. p. 32. 1836; Rose, H. J., *New Gen. Biog. Dict.* 7:453, 1850; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 180-181, 1874.
- FRISON, Theodore Henry (1895-1945). A., *Ent. News* 56:280, 1945; Davis, J. J., P., *Journ. Econ. Ent.* 38:729-730, 1945; Gibson, A., *Canadian Ent.* 78:23-24, 1946; Ross, H. H., *Ann. Ent. Soc. Amer.* 39:345, 1946; Ross, H. H., *Trans. Ill. Acad. Sci.* 39:154-155, 1946.
- FRIVALDSZKY VON FRIVALD, Eméric (1799-1870). Aigner, P., *Rovartani Lapok (Budapest)* 4:5-9; 4(3):2, 1897.
- FRIVALDSZKY, János (1822-1895). Mik, J., *Wiener Ent. Zeit.* 14:180, 1895; Kraatz, G., *Deutsche Ent. Ztschr.* 39:7, 1895; "E. M.," *Insekten-Börse* 12:75, 1895; A., *Miscellanea Ent.* 3:48-49, 1895; Horvath, G., B., P., *Termes Füzetek.* 20:1-16, 252-255, 1897; Csiki, E., P., *Rovartani Lapok (Budapest)* 10:23-25; 10(2):3, 1903.

- FROGGATT, Walter Wilson (1858-1937). Walkom, A. B., *P.*, Proc. Linn. Soc. N. S. Wales 67:77-81, 1942; Musgrave, A., *P.*, Proc. Roy. Zool. Soc. N. S. Wales pp. 43-44, 1937.
- FROHAWK, Frederick William (1861-1946). Riley, N. D., *P.*, Entomologist 80:25-27, 1947; Jackson, R. A., Proc. & Trans. Soc. Lond. Ent. & N. H. Soc. p. 56, 1946-47; A., Trans. Suffolk Nat. Soc. 6:lxiv, 1947.
- FROST, Harold Locke (1875-1940). A., Mass. State Coll. Fernald Club. Yearbook 10:41-42, 1941; Higgins, E. W., *l. c.* 11:1-3, 1942.
- FRUHSTORFER, Hans (1863-1922). Martin, L., Fruhstorfer Coll. of Butterflies pp. 3-8, 1922; Martin, L., Iris 36:96-103, 1922; Seitz, A., Ent. Rundschau 39:17, 1922.
- FRY, Alexander (1821-1905). Merrifield, F., Trans. Ent. Soc. Lond. (Proc.):lxxxvi, 1905.
- FRYER, John Claud Fortescue (1886-1948). Edelen, H. M., *B.*, Entomologist 82:47-48, 1949; Williams, C. B., Proc. Roy. Ent. Soc. Lond. (C) 13:67, 1948-49; Cockayne, E. A., Ent. Record 61:79, 1949; Thompson, W. R., Canadian Ent. 81:215, 1949.
- FUCHS, August (-1904). A., Insekten-Börse 21:51, 1904; Pagenstecher, A., Jahrb. Nassau. Ver. Naturk. 58:xii, 1905.
- FÜLLEBORN, Friedrich (1866-1933). A., Archiv Schiffs- und Tropenhyg. 37:437, 1933; "M.-B., P.," British Med. Journ. 2:588, 630, 1933; Manson-Bahr, P., *P.*, Trans. Roy. Soc. Trop. Med. & Hyg. 27:330-331, 1933; A., Journ. Parasitol. 20:95, 1934. Stunkard, H. W., *P.*, *l. c.* 20:203-206, 1934.
- FUENTE, José María de la (1855-1932). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:190, 1919; Español, F., Butl. Inst. Catalana Hist. Nat. 32:237-238, 1932.
- FÜESSLY, John Caspar (1743-1786). Rose, H. J., New Gen. Biog. Dict. 7:458, 1850.
- FÜRSTENAU, Johann Hermann (1688-1756). Rose, H. J., New Gen. Biog. Dict. 7:463, 1850.
- FUHR, Josef (1864-1941). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:66, 1942.
- FUHRMANN, Otto (1871-1945). Delachaux, T., et al., *B.*, *P.*, Bull. Soc. Neuchatel. Sci. Nat. 69:149-167, 1944; Delachaux, T., et al., *P.*, Verh. Schweiz. Naturf. Ges. 125:366-367, 1945.
- FULDA, Oscar (-1945). A., Bull. Bklyn. Ent. Soc. 40:71, 1945.
- FULLER, Claude (1872-1928). Horn, W., Anzeiger f. Schädlingssk. 5:27, 1929; A., *B.*, *P.*, So. African Journ. N. H. 6:236-240, 1929; *B.* only, Journ. Soc. Bibliog. Nat. Hist. (Lond.) 1:207-208, 1939.
- FUSS, Hermann (1824-1915). Hubenthal, W., Deutsche Ent. Ztschr. pp. 577-578, 1915.
- GADEAU DE KERVILLE, Henri (1858-1940). Regnier, R., *B.*, *P.*, Bull. Soc. Amis Sci. Nat. Rouen (9) 76:77-9:36, 1940-41; Regnier, R., Ann. Soc. Ent. France 110:51-52, 1941.
- GAEDEKEN, Carl Georg. (1832-1900). Engelhart, C., *P.*, Ent. Meddelelser 12:22-23, 1918.
- GAHAN, Charles Joseph (1862-1939). Arrow, G. J., *P.*, Entomologist 72:25-26, 1939.
- GAJL, Kazimierz (1896-1934). Jaczewski, T., Polskie Pismo Ent. 13:215-217, 1934.
- GALÁN Y RUIZ, Alfonso (-1919). Arias, J., Bol. Real Soc. Españ. 19:122-123, 1919.
- GALLARDO, Angel (1867-1934). Porter, C. E., *B.*, *P.*, Rev. Chilena Hist. Nat. 38:74-75, 1934; Lizer y Trelles, C. A., Curso de Entomologia 1:40-41, 1947.
- GALLEGOS, José María (-1925). Van Duzee, E. P., Pan-Pacific Ent. 2:96, 1925.
- GALLOIS, Jean (1632-1707). Rose, H. J., New Gen. Biog. Dict. 7:475, 1850.
- GALTON, Francis (1822-1911). A., Ent. Mo. Mag. 47:72, 1911.
- GANGLBAUER, Ludwig (1856-1912). A., Ent. Rundschau 1:99, 1912; Steindachner, F., et al., Verh. Zool.-Bot. Ges. Wien 62:(185)-(187), 1912; Spaeth, F., *B.*, *P.*, *l. c.* 62:417-435, 1912; Heikertinger, F., Koleopt. Rundschau 23:93-110, 1937.
- GARCÍA LÓPEZ, Angel (1888-1937). del Cañizo, J., *B.*, *P.*, Bol. Patol. Veg. y Ent. Agr. (Madrid) 10:361-363, 1941.
- GARCIA, Fabian (1871-1948). Eyer, J. R., *P.*, Journ. Econ. Ent. 41:1000-1001, 1948.

- GARCÍA MERCET, Ricardo (1860-1933). del Cañizo, J., *P.*, Bol. Patol. Veg. y Ent. Agr. (Madrid) 7:237-238, 1933; de Zulueta, A., Bol. Soc. Españ. Hist. Nat. 33:205, 1933; Dusmet y Alonso, J. M., *B.*, *P.*, Reseñas Cient. Soc. Españ. Hist. Nat. 8:113-126, 1933; Porter, C. E., *P.*, Rev. Chilena Hist. Nat. 37:271, 1933; Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:173-174, 1919.
- GARDE, Philip le Hardy de la (-1913). "J. H. K., Ent. Mo. Mag. 49:161-162, 1913; *A.*, Ent. Record 25:205, 1913.
- GARMAN, William Harrison (1858-1944). "P. G., *P.*, Journ. Econ. Ent. 37:720-721, 1944; Calvert, P. P., Ent. News 56:19-21, 1945; Osborn, H., Fragments Ent. Hist. 2:85, 1946.
- GARNEYS, William (1831-1881). *A.*, Ent. Mo. Mag. 18:163-164, 1881.
- GARRETT, Garrett (1868-1890). Garrett, J. R., *P.*, Trans. Suffolk Nat. Soc. 5:10, 12-14, 1942.
- GAY, Claudio (1800-1873). Yañez, P., *P.*, Rev. Chilena Hist. Nat. 48:8-21, 1944; Stuardo, C., et al., *P.*, La enseñanza de las ciencias naturales en los liceos Bosquejo historico (pub. by Mus. Pedagógico Chile) pp. 15-19, 1944; Lizer y Trelles, C. A., Curso de Entomología 1:23-24, 1947; Barros Arana, D., Anal. Univ. Chile 49:5-227, 1876; Barros Arana, D., *B.*, *P.*, Don Claudio Gay, su Vida, sus Obras, Santiago, Chile, 235 pp., 1876.
- GAYNER, Francis (1870-1933). *A.*, British Med. Journ. 2:1097, 1933.
- GBELER, Frederick Augustus (1782-1850). Mannerheim, C. G., von, *B.*, Bull. Soc. Imp. Nat. Moscou 23(2):580-591, 1850; Westwood, J. O., Trans. Ent. Soc. Lond. n. s. 1 (Proc.):138, 1850-51; Marseul, S. A. de, *B.* only, L'Abeille 21 (Les Ent. et leurs Ecrits):71-72, 1883.
- GEE, Nathaniel Gist (1876-1937). Pickens, A. L., Auk 56:111, 1939.
- GENENBAUR, Carl (1826-1903). von Hanstein, R., Naturw. Rundschau 18: 478-479, 490-492, 1903; Hertwig, P., *P.*, Smithsonian. Rpt. for 1904 pp. 787-791, 1905; "H. F. G., *P.*, Proc. Roy. Soc. Lond. 75:309-312, 1904-05.
- GEMIGNANI, Emilio V. (1897-1949). *A.*, *B.*, Rev. Soc. Ent. Arg. 14:240-243, 1949.
- GEMMINGER, Max (1820-1887). Will, F., Ent. Nachrichten 13:237-238, 1887; Dohrn, C. A., Stettiner Ent. Zeit. 48:206-207, 1887.
- GENLIS, Stéphanie Félicité Ducrest de Saint Aubin de (1746-1830). Rose, H. J., New Gen. Biog. Dict. 7:502, 1850.
- GEOFFROY, Étienne Louis (1727-1810). Eiselt, J. N., Geschichte, Systematik und Literatur der Insecten. pp. 48-50, 1836; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 182, 1874; Rose, H. J., New Gen. Biog. Dict. 7:506, 1850; Lizer y Trelles, C. A., Curso de Entomología 1:9, 1947.
- GEOFFROY, SAINT-HILAIRE, Étienne Louis (1772-1844). Guérin-Méneville, F. E., Revue Zoologique 7:288, 1844; Flourens, P. (trans. by C. A. Alexander), Ann. Rpt. Smithsonian Inst. for 1861 pp. 161-174, 1862; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 182 (footnote), 1874; Beltran, E., Rev. Soc. Mexicana Hist. Nat. 5:155-166, 1944.
- GEORG, Wilhelm (1817-1869). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 182-183, 1874.
- GEORGE, Dorothy Chauncey (1887-1938). *A.*, Phytopathology 29:389, 1939.
- GERASIMOU, Aleksei Maksimovich (1904-1942). Kozhanchikov, I. V., *B.*, *P.*, Rev. Ent. URSS 30: 165-167, 1948.
- GERGER, Eduard (1838-1907). Csiki, E., Rovartani Lapok (Budapest) 14:139-140; 14(7):9, 1907.
- GERMAIN, Filiberto (1827-1913). Porter, C. E., *B.*, *P.*, Rev. Chilena Hist. Nat. 7:249-253, 1903; Porter, C. E., *P.*, *I. c.* 17:245-255, 1913; Porter, C. E., *B.*, Actes Soc. Sci. Chili 24:1-9, 1917.
- GERMAR, Ernst Friedrich (1786-1853). Newman, E., *B.*, Zoologist 12:4228-4229, 1854; Schaum, H., *B.*, Stettiner Ent. Zeit. 14:375-390, 1853; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 184-185, 1874; Marseul, S. de, *B.* only, L'Abeille 21 (Les Ent. et leurs Ecrits):112-117, 1883.
- GERSTÄCKER, Carl Eduard Adolph (1828-1895). *A.*, Leopoldina 31:168, 1895; Mel-dola, R., Trans. Ent. Soc. Lond. (Proc.):lxxi-lxxii, 1895.

- GESNER, Conrad (1516-1558). Eisele, J. N., *Geschichte, Systematik und Literatur der Insectenk.* pp. 16-17, 1836; Jardine, W., *P., Naturalist's Library* 20:17-58, 1848; Lizer y Trelles, C. A., *Curso de Entomologia* 1:6-7, 1947.
- GESSNER, Johann (1709-1790). Wolf, J. R., *P., Neujahrsbl. Naturf. Ges. Zürich (An die zürcherische Jugend)* 48:1-27, 1846; Rudolphi, F., *P., Festschr. Naturf. Ges. Zürich* 1746-1896 pp. 58-64, 1896.
- GESTRO, Raffaello (1845-1935). Porter, C. E., *Rev. Chilena Hist. Nat.* 40:439, 1936; Masi, L., *B., P., Riv. Biol. (Firenze)* 22:183-195, 1937.
- GEYER, G. Guyula (Julius) (1828-1900). Aigner-Abafi, L., *Rovartani Lapok (Budapest)* 14:47-49; 14(3-4):3-4, 1907.
- GHILIANI, Victor (1812-1878). Goss, H., *Ent. Mo. Mag.* 15:167, 1878; "P. S.," *Bull. Soc. Ent. Ital.* 10:228, 1878; Lessona, M., *B., Ann. R. Accad. Agr. Torino* 22:65-79, 1879; Kraatz, G., *Deutsche Ent. Ztsch.* 23:21, 1879.
- GIACOMELLI, Eugenio (1879-1941). A., *B., Rev. Soc. Ent. Arg.* 14:223-227, 1949; A., *Rev. Soc. Ent. Arg.* 11:293, 1942; Lizer y Trelles, C. A., *Curso de Entomologia* 1:51, 1947.
- GIARD, Alfred (1846-1908). Dantec, F. le, et al., *B., P., Bull. Sci. France et Belg.* 42:iii-lxxiii, 1909; "B. D. J.," *Proc. Linn. Soc. Lond.* 121:40, 1909.
- GIBBS, Arthur Ernest (1859-1917). Gahan, C. J., *Trans. Ent. Soc. Lond. (Proc.)*:cxii, 1917.
- GIBSON, Lester Ernest (1889-1942). Osborn, H., *Fragments Ent. Hist.* 2:85, 1946.
- GIEBEL, Christoph Gottfried Andreas (1820-1881). A., *Ent. Mo. Mag.* 18:215, 1882.
- GIFFARD, Walter M. (1856-1929). Swezey, O. H., et al., *P., Proc. Haw. Ent. Soc.* 7:347-351, 1931.
- GILL, Theodore Nicholas (1837-1914). Palmer, T. S., *P., Auk* 32:391-405, 1915.
- GILL, Walter Battershell (-1900). A., *Ent. Mo. Mag.* 36:66-67, 1900; Verrall, T. H., *Trans. Ent. Soc. Lond. (Proc.)*:xliii, 1900.
- GILLETTE, Clarence Preston (1859-1941). Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 8:212-213, 1941; Osborn, H., *Fragments Ent. Hist.* 2:85-86, 1946.
- GILLIATT, Frederick Courteney (1889-1938). Osborn, H., *Fragments Ent. Hist.* 2:86-87, 1946.
- GILLO, Robert (-1891). A., *Ent. Mo. Mag.* 27:200, 1891.
- GINANNI, Francesco (1716-1766). A., *Nova Acta Acad. Leopold-Carol. Nat. Cur.* 4 (Suppl.):297-298, 1770; Rose, H. J., *New Gen. Biog. Dict.* 8:31, 1850.
- GINER, Mari José (1901-1946). Ignacio Sala, P., *B., P., Graellsia (Rev. Ent. Espan.)* 4:81-87, 1946; Ignacio Sala, P., *P., Rev. Iberica* 116:1-7, 1947.
- GIOVANNOLA, Arnaldo (1910-1939). Corradetti, A., *B., P., Riv. di Parassitol.* 3:345-350, 1939.
- GIRARD, Maurice Jean Auguste (1822-1886). Simon, E., *Ann. Soc. Ent. France* (6) 6 (Bull.):cxlvi-cxlvii, 1886.
- GIRAUD, Joseph Etienne (1808-1877). Marseul, S. de, *B. only, L'Abeille* 21 (Les Ent. et leurs Ecrits):110-112, 1883.
- GISTEL, (GISTL), Johannes von Nepomuk Franz Xaver (1803(?)-1873). Mannerheim, C. G. von, *Bull. Soc. Imp. Nat. Moscou* pp. 205-211, 1838. (Review of his works).
- GLASENAPP, Sergej Pawlowitch (1848-1937). A., *Arb. Phys. Angew. Ent. Berlin-Dahlem* 4:246, 1937.
- GLASER, Rudolf William (1888-1947). Stoll, N. R., *P., Journ. Parasitol.* 34:165-168, 1948; Weiss, H. B., *Ann. Ent. Soc. Amer.* 42:238-239, 1949.
- GLASGOW, Hugh (1884-1948). Hartzell, F. Z., *P., Journ. Econ. Ent.* 41:837-838, 1948; A., *Ann. Ent. Soc. Amer.* 42:239, 1949.
- GLEDITSCH, Johann Gottlieb (1714-1786). Rose, H. J., *New Gen. Biog. Dict.* 8:40, 1850; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 187-190, 1874.
- GLEICHEN, (RUSSWORM) Wilhelm Friedrich von (1717-1783). A., *B., Schrift. Berlin. Ges. Naturf. Freunde* 5:491-496, 1784; Rose, H. J., *New Gen. Biog. Dict.* 8:40, 1850.
- GLENN, Pressley Adams (1867-1937). Osborn, H., *Fragments Ent. Hist.* 2:87, 1946.
- GLITZ, Christian Theodor (1818-1889). Staudinger, O., *Stettin. Ent. Zeit.* 51:8-10, 1890.

- GLOVER, Townend (1812-1883). Riley, C. V., *Amer. Nat.* 17:1072, 1883.
- GMELIN, Johann Friedrich (1748-1804). Rose, H. J., *New Gen. Biog. Dict.* 8:44, 1850; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 190-191, 1874.
- GODMAN, Frederick DuCane (1834-1919). Champion, G. C., *Ann. Soc. Ent. Belg.* 59:32, 1919; *A.*, *Ent. Record* 31:173-174, 1919; Woodward, A. S., *Quart. Journ. Geol. Soc. Lond.* 76:liv-lv, 1920; "H. J. E." *P.*, *Proc. Roy. Soc. Lond. (B)* 91:i-vi, 1920.
- GOEDART, Johann (1620-1668). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insecten*. pp. 21-22, 1836.
- GOELDI, Emil August (1859-1917). *A.*, *Physis* 4:381, 1918; Lizer y Trelles, C. A., *Curso de Entomologia* 1:21, 1947; Howard, L. O., *P.*, *Pop. Sci. Monthly* 87:171, 1915.
- GÖLDI-BRAUN, Robert (1861-1940). Jögren, S., *Bitidningen* 39:229-230, 1940.
- GÖLLER, Ernst (-1938). Pillel, S., *Ent. Zeitschrift (Frankfurt)* 52:117-118, 1938.
- GOETHE, Johann Wolfgang von (1749-1832). Rose, H. J., *New Gen. Biog. Dict.* 8:53-54, 1850.
- GOETSCHMANN, Theodor (1852-1912). Dittrich, R., *P.*, *Ent. Zeitschrift (Frankfurt)* 26:48, 1912; Dittrich, R., *Jahresh. Ver. Schles. Insektenk. Breslau* 5:xxii-xxv, 1912.
- GOFF, Carlos Clyde (1905-1939). Watson, J. R., *B.*, *Florida Ent.* 22:12-13, 1939; Goin, C. J., *Florida Ent.* 22:63-65, 1939.
- GOFF, Dorothy Clara Schultz (1907-1937). *A.*, *Florida Ent.* 20:5-6, 1937.
- GOLDFUSS, Georg August (1782-1848). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 48 (footnote), 1874.
- GOLDSMITH, Oliver (1728-1774). Rose, H. J., *New Gen. Biog. Dict.* 8:57-58, 1850.
- GOLTZ, D. von der (1864-1941). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin Dahlem* 9:65, 1942; Calliess, G., *Internat. Ent. Ztschr.* 28:145-146, 1934; account of travels, *l. c.*, *P.* 28:146-154, 169-175, 180-182, 1934.
- GOMES, João Florencio de Salles (1886-1919). Taunay, A. d'E., *B.*, *P.*, *Rev. Mus Paulista* 11:563-575, 1919.
- GOODRICH, Edwin Stephen (1868-1946). Beer, G. R., *Nature* 157:184-185, 1946.
- GOOSEY, William (-1878). Pratt, D., *Entomologist* 12:64, 1879.
- GORDON, George (1801-1893). Trail, J. W. H., *P.*, *Ann. Scottish Nat. Hist.* pp. 65-71, 1894.
- GORDON, William M. (-1944). *A.*, *Ent. News* 55:86, 1944.
- GORGAS, William Crawford (1854-1920). Howard, L. O., *P.*, *Pop. Sci. Mo.* 87:180, 1915; Stockard, G. C., *P.*, *Pan Amer. Mag.* 42:196-200, 1929; Hastings, M., *l. c.* 42:291-293, 1930.
- GÓRRIZ, Ricardo do José (-1916). Dusmet y Alonso, Bol. Soc. Ent. España 2:162, 1919.
- GOSS, Herbert (-1908). Waterhouse, C. O., *Trans. Ent. Soc. Lond. (Proc.)*:cv-cvi, 1908.
- GOSS, Philip Henry (1810-1888). Carrington, J. T., *Entomologist* 21:264, 1888.
- GOUREAU, Claude Charles (1790-1879). Fauvel, A., *Annuaire Ent.* pp. 120-121, 1880.
- GOZIS, Maurice des (-1909). Horn, W., *Deutsche Ent. Ztschr.* p. 687, 1909; *A.*, *Ent. Rundschau* 26:86, 1909.
- GRABER, Veit (1844-1892). Jaworowski, A., *B.*, *P.*, *Wiener Ent. Zeit.* 11:253-262, 1892; Mik, J., *l. c.* 11:120, 1892; Sharp, D., *Entomologist* 26:68, 1893; Jaworowski, A., *B.*, *Mitt. Ver. Steiermark* 29:224-232, 1894.
- GRABOW, Carl Wilhelm Louis (1790-1859). Sorhagen, L., *Allg. Ztschr. f. Ent.* 6:241-242, 1901.
- GRABOWSKI, Marjan (1864-1930). "N." *Polskie Pismo Ent.* 9:292-293, 1930.
- GRAËLLS, Mariano de la Paz (1809-1898). *A.*, *Ent. Mo. Mag.* 34:140, 1898; Bouvier E. L., *Bull. Soc. France* p. 43, 1898; Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:83-84, 1919; Calderon, S., *Anal. Soc. Espan. Hist. Nat.* 27 (Acta):66-67, 1898.
- GRAENICHER, Sigmund (1855-1937). Osborn, H., *Fragments Ent. Hist.* 2:87, 1946.
- GRAESER, Friedrich (1840-1913). Kuhn, P., *Deutsche Ent. Ztschr.* pp. 356-357, 1914.
- GRASSI, Giovanni Battista (1854-1925). Cotronei, G., *P.* (opp. p. 1), *Riv. di Parassitol.*

- (Roma) 2:73-78, 1938; Blasi, D. de, P., Riv. di Biol. (Firenze) 25:426-435, 1938; Howard, L. O., P., Pop. Sci. Mo. 87:71, 1915; Silvestri, F., P., Mem. R. Accad. Naz. Lincei Classe Sci. Fis., Mat. e Nat. (6) 2(2):ix-lxiii, 1927; Fedele, M., B., P., Boll. Soc. Nat. Napoli 38 (Append.):59-93, 1926 (1927).
- GRASSMAN, Peter Chase (1925-1944). Essig, E. O., Ann. Ent. Soc. Amer. 39:344-345, 1946.
- GRAY, John (-1881). A., Ent. Mo. Mag. 18:190-191, 1882.
- GRAY, John (-1878). Somerville, J., Glasgow Nat. 2:68-69, 1910.
- GRAY, John Edward (1800-1875). A., Journ. de Zool. 4:96-97, 1875; Saunders, S. S., Trans. Ent. Soc. Lond. (Proc.):xxxi, 1875.
- GREBE, Carl Friedrich August (1816-1890). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 201-205, 1874.
- GREDLER, P. Vincenz (-1904). Daniel, K., Münch. Koleopt. Ztschr. 2:392, 1906.
- GREEN, Edward Ernest (1861-1949). Laing, F., P., Ent. Mo. Mag. 85:215-216, 1949.
- GREENE, Joseph (1824-1906). A., Ent. Mo. Mag. 42:66-67, 1906; A., Ent. Record 18:82, 1906; Merrifield, F., Trans. Ent. Soc. Lond. (Proc.):cxiii, 1906.
- GREENING, Noah (-1879). A., The Naturalist (Journ. Yorkshire Nat. Union) 5:77, 1879; Carrington, J. T., Entomologist 12:300, 1879; Birchall, E., Ent. Mo. Mag. 16:167, 1879.
- GREER, Thomas (-1949). "B. P. B.," Entomologist 82:215-216, 1949.
- GREINER, Johann (1863-1938). Heikertinger, F., Koleopt. Rundschau 25:78, 1939.
- GREW, Nehemiah (1641-1712). Rose, H. J., New Gen. Biog. Dict. 8:118-119, 1850; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 205-207, 1874.
- GRIEBEL, Julius (-1919). Hedicke, H., Deutsche Ent. Ztschr. p. 233, 1919.
- GRIFFITH, Horace Greeley (-1899). A., Ent. News 10:252, 1899.
- GRIMES, Dillard Wister (1891-1943). Osborn, H., Fragments Ent. Hist. 2:87-88, 1946.
- GRIMM, Adam (1824-1876). Pellett, K. L., P., Amer. Bee Journ. 69:608-609, 1929.
- GRIMSHAW, Percy Hall (1869-1939). Ritchie, J., Nature 144:1004, 1939; Ritchie, J., P., North Western Nat. 14:290-291, 1939; Ritchie, J., Proc. Roy. Soc. Edinb. 60:392-393, 1941; Smart, J., B., Journ. Soc. Bibliog. Nat. Hist. 2:39-42, 1945.
- GRINNELL, Fordyce, Jr. (1882-1943). A., Bull. So. Calif. Acad. Sci. 42:136-137, 1943.
- GRISWOLD, Grace Hall (1872-1946). Johannsen, O. A., Journ. Econ. Ent. 39:423-424, 1946; Johannsen, O. A., Ann. Ent. Soc. Amer. 39:346-347, 1946.
- GRÖNLIN, Nils (1874-1939). Knaben, N., B., P., Norsk Ent. Tidsskrift 5:192-194, 1940; Hellén, W., Notulae Ent. 23:59, 1943.
- GROSIER, Jean Baptiste Gabriel Alexandre (1743-1823). Rose, H. J., New Gen. Biog. Dict. 8:131, 1850.
- GROSS, Julius (-1933). A., Zool. Anzeiger 102:339, 1933.
- GROSSINGER, János Baptist (1728-1803). Aigner, L., Rovartani Lapok (Budapest) 4:69-71, 1897.
- GROTE, August Radcliffe (1841-1903). A., P., Insekten-Börse 20:305, 1903; A., Ent. Record 15:273, 1903; Remington, J. E., P., Lepidopterists' News 2:17, 1948; Bode, W., B., P., Allg. Ztschr. f. Ent. 9:1-6, 1904.
- GROTH, Claus Hinrich (1859-1930). Zirk, W., Verh. Ver. Naturw. Heimatforsch. (Hamburg) 22:xix-xx, 1930.
- GROUVELLE, Jules (-1923). A., Ent. News 35:303, 1924; Rabaud, E., Bull. Soc. Ent. France p. 213, 1923.
- GROUVELLE, Philippe (-1923). A., Ent. News 35:303, 1924; Rabaud, E., Bull. Soc. Ent. France pp. 185-186, 1923.
- GRÜBE, Adolph Eduard (1812-1880). Zaddach, G., B., Schrift. Phys.-Ökon. Ges. Königsberg 21:113-130, 1880; Müller, K., Die Natur. 29:410, 1880; A., Zool. Anzeiger 3:336, 1880; Wiesner, J., Verh. Zool.-Bot. Ges. Wien 30 (Sitzb.):39-40, 1880.
- GRUNACK, Albert (1842-1907). A., Ent. Zeitschrift 21:90, 102, 160, 1907; Krancher, O., P., Ent. Jahrbuch 17:200, 1908.
- GRUNERT, Julius Theodor (1809). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 208-213, 1874.
- GRUT, Ferdinand (1820-1891). McLachlan, R., Ent. Mo. Mag. 27:251-252, 1891;

- Weir, J. J., *Entomologist* 24:224, 1891; *A.*, *Ent. Record* 2:157, 1891; Boucard, A., *The Hummingbird* 1:97, 1891; Godman, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:L, 1891.
- GSCHWANDNER, Robert (1875-1927). Rebel, H., *Ann. Naturh. Mus. Wien* 42(1), 1928; Rebel, H., *P.*, *Verh. Zool.-Bot. Ges. Wien* 77:(109)-(112), 1927; Berger, J. F., *B.*, *P.*, *Ztschr. Oesterr. Ent. Ver.* 12:53-57, 1927.
- GUÉNÉE, Achille (1809-1880). *A.*, *Le Naturaliste* 3:351, 1881; Stainton, H. T., *Trans. Ent. Soc. Lond. (Proc.)*:l-lv, 1881.
- GÜNTHER, Hans (1895-1931). Aue, A. U. E., *Ent. Anzeiger* 11:203-204, 1931.
- GUÉRIN-MÉNEVILLE, Félix Édouard (1799-1874). Marseul, S. de, *B.*, only, *L'Abeille* 21 (Les Ent. et leurs Écrits):75-100, 1883.
- GUETTARD, Jean Etienne (1715-1756). Rose, H. J., *New Gen. Biog. Dict.* 8:146, 1850.
- GUIMARAES, José Geminiano Gomes (-1935). *A.*, *O Campo* 7:23, 1937.
- GUITERAS, Juan (1852-1925). Tovar, E. G., *B.*, *Rev. Med. Trop. y Parasitol.* 10:49-63, 1944.
- GULDE, Johannes (1872-1929). Sack, P., *P.*, *Ber. Senckenb. Naturf. Ges.* 60:48, 1930.
- GUMILLA, José (c. 1758). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:78-79, 1919.
- GUNDER, Jeanne Daniel (1888-1948). Martin, L. M., *Lepidopterists' News* 2:105, 1948.
- GUNDLACH, Juan Cristobal (Johannes Christopher) (1810-1896). Lopez, G., *P.*, *Anal. R. Acad. Cienc. Med., Fis. y Nat. Habana* 32:463-465, 1896; Vilaro, J., *Pop. Sci. Mo.* 50:691-697, 1897; Torre y Huerta, C. de la, *B.*, *P.*, *Mem. Soc. Cubana Hist. Nat.* 3:146-168, 1918; Lizer y Trelles, C. A., *Curso de Entomologia* 1.28, 1947.
- GURNEY, William Butler (1882-1939). Holmes, J. M., *Proc. Linn. Soc. N. S. Wales* 65:ii-ii, 1940.
- GUSMANN, Paul (1866-1942). Benick, L., *B.*, *Verh. Ver. Naturw. Heimatforsch. Hamburg* 29:xiv-xv, 1947.
- GWATKIN-WILLIAMS, Rupert Stanley (1875-1949). Cockayne, E. A., *Ent. Record* 61:92, 1949.
- GYLEK, Ludwig (1864-1923). Hoffmann, A., *Ent. Anzeiger* 3:101-102, 1923.
- GYLLENHAL, Leonhard (1752-1840). *A.*, *Rev. et Mag. Zool.* 3:224, 1840; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 216-217, 1874; Marseul, S. de, *B.*, only, *L'Abeille* 21 (Les Ent. et leurs Écrits):74, 1883; Essig, E. O., *P.*, *Hist. of Ent. pp.* 642-643, 1931.
- HAECKEL, Ernst (-1919). *A.*, *Ent. Blätter* 15:255, 1919.
- HAGEMANN, Axel Otto Christian (1856-1907). *Natvig, L. R.*, *B.*, *P.*, *Norsk Ent. Tidsskrift* 7:47, 1944.
- HAGEN, Hermann August (1817-1893). *A.*, *Leopoldina* 29:208, 1893; Elwes, H. J., *Trans. Ent. Soc. Lond. (Proc.)*:lv, 1893; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 219-221, 1874.
- HAGGAR, George (-1892). Douglas, J. W., *Ent. Mo. Mag.* 28:112, 1892.
- HAGLUND, Carl Johan Emil (1837-1901). Sjöstedt, Y., *B.*, *P.*, *Ent. Tidsskrift* 23:41-46, 1902.
- HAHN, Carl Wilhelm (1786-1836). Bonnet, P., *Bibliographia Araneorum* p. 32, 1945.
- HAHNEL, Paul (1843-1887). Staudinger, O., *Iris* 3:128-132, 1890.
- HAINES, Frederick Haslewood (1864-1946). "F. C. F.," *Ent. Mo. Mag.* 82:96, 1946; *A.*, *P.*, *Journ. Soc. Brit. Ent.* 3:37-39, 1946.
- HALÁSZ, Árpád (1857-1904). *A.*, *B.*, *Rovartani Lapok (Budapest)* 11:194, 1904.
- HALBERT, James Nathaniel (-1948). Beirne, B. P., *Ent. Mo. Mag.* 84:167, 1948.
- HALDE, Jean Baptiste du (1674-1743). Rose, H. J., *New Gen. Biog. Dict.* 8:175, 1850.
- HALE, Matthew (1609-1676). Rose, H. J., *New Gen. Biog. Dict.* 8:175-176, 1850.
- HALL, Christopher George (1842-1890). *A.*, *Ent. Mo. Mag.* 26:304-305, 1890; *A.*, *Entomologist* 23:328, 1890.
- HALL, Maurice Crowther (1881-1938). *A.*, *P.*, *N. A. Veterinarian* 19(6):70-71, 1938.
- HALLER, Albrecht von (1708-1777). Rose, H. J., *New Gen. Biog. Dict.* 8:184-186, 1850.
- HAMA, Tsugio (1907-1939). *A.*, *B.*, *P.*, *Kontyu* 13:272, 1939.
- HAMBLETON, James Chase (1863-1938). Osborn, H., *P.*, *Fragments Ent. Hist.* 2:88, 1946.

- HAMFELT, Harry Kristian (1892-1938). Kemner, N. A., *P.*, *Opuscula Ent.* 4:112, 1939.
- HAMLIN, John Calhoun (1896-1943). Osborn, H., *P.*, *Fragments Ent. Hist.* 2:88-89, 1946.
- HAMMARSTRÖM, Edward Rudolf (1863-1928). Forsius, R., *Notulae Ent.* (Finland) 8:62-63, 1928.
- HANCOCK, George L. R. (-1940). Gedge, A. F. J., *Journ. E. Afr. Uganda Nat. Hist. Soc.* 15:83-84, 1940.
- HANDLIRSCH, Adam (1864-1890). Brauer, F., *B.*, *P.*, *Verh. Zool.-Bot. Ges. Wien* 40:515-516, 1890.
- HANDLIRSCH, Anton (1865-1935). Escherich, K., *P.*, *Anz. f. Schädlingk.* 12:47, 1936; Esaki, T., *P.*, *Mushi* 10:152-155, 1937.
- HANELD, Wilhelm (-1910). Kuhnt, P., *Deutsche Ent. Ztschr.* pp. 329-330, 1910.
- HANHAM, Abdiel William (1857-1944). Downes, W., *B.*, *Proc. Ent. Soc. Br. Col.* 42:27-28, 1945.
- HANITSCH, Richard (1860-1940). Imms, A. D., et al., *Nature* 146:360, 1940.
- HANSEN, Pedro Jørgensen (1865-1937). Molfino, J. T., *Physis (Arg.)* 12:407-408, 1938.
- HARBISON, John Stewart (1826-1912). Pellett, K. L., *P.*, *Amer. Bee Journ.* 69:556-558, 1929.
- HARDY, James (1815-1898). *A.*, *Ent. Mo. Mag.* 35:16-17, 1899; Bolam, G., *Ann. Scottish N. H. pp.* 1-6, 1899; Ferguson, J., *B.*, *Hist. Berwickshire Club* 16:341-372, 1896-98.
- HARFORD, W. G. W. (1825-1911). Essig, E. O., *P.*, *Hist. of Ent.* pp. 650-651, 1931.
- HARKER, James Allen (1848-1894). *A.*, *Proc. Linn. Soc. Lond.* p. 32, 1894-95; *A.*, *Nat. Science* 6:137, 1894.
- HARMAN, Samuel Willard (1894-1948). Hartzell, F. Z., *P.*, *Journ. Econ. Ent.* 41:838-839, 1948.
- HAROLD, Edgar von (1830-1886). McLachlan, R., *Trans. Ent. Soc. Lond. (Proc.)*:lxv-lxvi, 1886.
- HARPER, Alfred (1813-1884). *A.*, *Entomologist* 17:264, 1884.
- HARPER, Philip Henry (-1883). Dunning, W. J., *Trans. Ent. Soc. Lon. (Proc.)*:xlii, 1883.
- HARRIS, Herbert George (-1942). Russell, S. G. C., *Ent. Record* 54:147-148, 1942.
- HARRIS, John Thomas (-1892). Fowler, W. W., *Ent. Mo. Mag.* 28:291, 1892; Godman, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:lv-lvi, 1892.
- HARRIS, Thaddeus Mason (1768-1842). Weiss, H. B., *Pioneer Century of American Entomology* pp. 41-42, 1936.
- HARRISON, Albert (1860-1911). *A.*, *Entomologist* 44:328, 1911.
- HARRISON, John (1693-1776). Rose, H. J., *New Gen. Biog. Dict.* 8:218, 1850.
- HARRISON, John (-1907). Waterhouse, C. O., *Trans. Ent. Soc. Lond. (Proc.)*:xcvii, 1907; Porritt, G. T., *Ent. Mo. Mag.* 43:211, 1907.
- HART, Esther Hastings (1862-1940). Osborn, H., *Fragments Ent. Hist.* 2:89, 1946.
- HARTMANN, August (-1880). Harold, E. von, *Mitt. Muench. Ent. Ver.* 4:175-176, 1880.
- HARWOOD, Bernard Smith (1876-1933). Gilles, W. S., *Entomologist* 66:264, 1933.
- HARWOOD, William Henry (1840-1917). Edwards, S., *Proc. So. Lond. Ent. & N. H. Soc.* p. 37, 1918-19.
- HASEBROEK, Karl (1860-1941). Albers, T., *Verh. Ver. Naturw. Heimatforsch. Hamburg* 29:xv-xvii, 1947; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 9:65, 1942.
- HASSALL, Albert (1862-1942). Price, E. W., et al., *P.*, *Journ. Parasitol.* 29:233-235, 1943; Osborn, H., *Fragments Ent. Hist.* 2:89, 1946.
- HASSELQUIST, Frederik (1722-1752). Rose, H. J., *New Gen. Biog. Dict.* 8:226-227, 1850.
- HASSELT, Alexander Willem Michiel van (1814-1902). Leesberg, A. F. A., *Tidschr. Ent.* 46:71-77, 1903; Binnendijk, J., *Ned. Tidschr. Geneesk. (2)* 38:573-575, 1902; Bonnet, P., *P.*, *Bibliographia Araneorum* pp. 36-37, 1945.
- HAUPT, R., von (-1916). Soldanski, H., *Deutsche Ent. Ztschr.* p. 227, 1916.

- HAUSCHILD, Louis Marcus (1840-1913). Kryger, J. P., *P.*, Ent. Meddelelser 12:25-29, 1918.
- HAUSER, Gustav (-1935).. A., Arb. Morph. Taxon. Ent. Berlin-Dahlem 2:218, 1935.
- HAUY, René Just (1743-1822). Rose, H. J., New Gen. Biog. Dict. 8:230, 1850.
- HAVILAND, Maud Dora (See under BRINDLEY).
- HAWKESWORTH, John (1715-1773). Rose, H. J., New Gen. Biog. Dict. 8:232, 1850.
- HAWKINS, Kenneth (1890-1946). A., *P.*, Journ. Econ. Ent. 39:681, 1946.
- HAWORTH, Adrian Hardy (1767-1883). "T. S.," Trans. Hull Club 1:229-232, 1901.
- HEADLEE, Thomas Jefferson (1877-1946). Weiss, H. B., Ann. Ent. Soc. Amer. 39:347-348, 1946; Peairs, L. M., et al., *P.*, Journ. Econ. Ent. 39:681-683, 1946.
- HEARDER, George Jonathon (-1894). A., Ent. Mo. Mag. 30:65-66, 1894.
- HEARSEY, John Bennett (-1865). Pascoe, F. P., Trans. Ent. Soc. Lond. (3)2 (Proc.):138-139, 1864-66.
- HEBARD, Morgan (1887-1946). Rehn, J. A. G., *P.*, Ent. News 59:57-69, 1948.
- HEBENSTREIT, Johann Ernst (1703-1757). Rose, H. J., New Gen. Biog. Dict. 8:242, 1850.
- HEBERDEN, William (1710-1801). Rose, H. J., New Gen. Biog. Dict. 8:244, 1850.
- HECQUET, Philipp (1661-1737). Rose, H. J., New Gen. Biog. Dict. 8:245-246, 1850.
- HEDEMANN, Wilhelm von (1836-1903). Kusnezov, N. J., Rev. Russe d'Ent. 4:62, 1904; Rebel, H., B., Verh. Zool.-Bot. Ges. Wien 53:421-423, 1903; Gudmann, F. C. J., *P.*, Ent. Meddelelser 12:23-24, 1918.
- HEDGREN, Gustaf Wilhelm (1894-1942). Lindroth, C. H., Ent. Tidskrift 65:36, 1944.
- HEDICKE, Hans (-1949). Kerrich, G. J., Ent. Mo. Mag. 85:264, 1949.
- HEER, Oswald (1809-1883). Rudio, F., B., *P.*, Festschr. Naturf. Ges. Zürich 1746-1896 pp. 87-89, 1896.
- HEGNER, Robert (1880-1942). Beltran, E., *P.*, Rev. Soc. Mex. H. N. 3:183-192, 1942; Cort, W. W., Journ. Parasitol. 28:175-177, 1942; Cort, W. W., *P.*, Rev. Med. Trop. y Parasit., Bact., Clinica y Lab. 8:1, 1942; Osborn, H., Fragments Ent. Hist. 2:89-90, 1946.
- HEINRICH, Rudolf (1859-1939). Calliess, G., B., *P.*, Internat. Ent. Ztschr. 28:177-180, 1934.
- HEISTER, Lorenz (1683-1758). Rose, H. J., New Gen. Biog. Dict. 8:251, 1850.
- HELLERS, Gustaf Adolf (1889-1940). A., *P.*, Bitidningen 38:19-20, 1939; A., *I. c.* 39:21, 1940.
- HELLIESEN, Tor (1855-1914). Natvig, L. R., B., Ent. Blätter 11:128, 1915.
- HELLINS, John (1829-1887). A., Ent. Mo. Mag. 24:20, 1887.
- HENDERSON, William Williams (1879-1944). Tanner, V. M., B., *P.*, Great Basin Nat. 5:23-24, 1944; A., *P.*, Farm & Home Sci. (Utah) 5(2):2, 1944; Sorenson, C. J., *I. c.* 5(4):4, 6, 1944; Sorenson, C. J., Science 100:583-584, 1944; Sorenson, C. J., Ann. Ent. Soc. Amer. 38:141-142, 1945.
- HENNERT, Carl Wilhelm (1739-1800). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 235-237, 1874.
- HENNIN DE BOUSSU-WALCOURT, Dom Guy de (-1945). Collart, A., Bull. & Ann. Soc. Ent. Belg. 81:77, 1945.
- HENNING, Johann Friedrich (-1831). Kühlwein, Bull. Moscou 4:40, 1832.
- HENNING, Otto (-1948). Horion, A., Koleopt. Zeitschrift 1:78, 1949.
- HENRIKSEN, Kai Ludwig (1888-1940). Thomsen, M., *P.*, Vidensk. Medd. Dansk Naturh. Foren. Kobenh. 104:v-xii, 1941; Natvig, L. R., Norsk Ent. Tidsskrift 6:49-50, 1941; Krogerus, R., *P.*, Notulae Ent. 21:1-2, 1941; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 7:335-336, 1940.
- HENSCHTEL, Gustav A. O. (1835-1895). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 237-238, 1874.
- HENSEL, Walter (1889-1921). Hensel, W., Jahresh. Ver. Insektenk. Breslau 14:27-28, 1924.
- HENSHAW, Samuel (1852-1941). Osborn, H., Fragments Ent. Hist. 2:90, 1946.
- HENTZ, Nicholas Marcellus (1797-1856). Cobb, C., *P.*, Journ. Elisha Mitchell Sci. Soc. 47:47-51, 1932; Bonnet, P., *P.*, Bibliographia Araneorum p. 33, 1945.
- HEPP, Albert (1883-1941). A., Ent. Blätter 37:176, 1941; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 8:287, 1941.

- HERBST, Johann Friedrich Wilhelm (1743-1807). *A.*, Ges. Naturf. Freunde Berlin Mag. 1:x-xii, 1807; Rose, H. J., New Gen. Biog. Dict. 8:291, 1850; Marseul, S. A. de, *B.* only, L'Abeille 24 (Les Ent. et leurs Écrits):186-187, 1887.
- HERBST, Paul (1861-1927). Lizer y Trelles, C. A. Curso de Entomologia 1:26, 1947.
- HERING, Eduard von (1779-1881). von Rueff, B., Jahresh. Ver. Väterl. Naturk. Württemberg 38:42-50, 1882.
- HERISSANT, Louis Antoine Prosper (1745-1769). Rose, H. J., New Gen. Biog. Dict. 8:292, 1850.
- HERMANN, Johann (1738-1800). Rose, H. J., New Gen. Biog. Dict. 8:292-293, 1850.
- HERMANN, Otto (1835-1914). Bonnet, P., Bibliographia Araneorum pp. 41-42, 1945.
- HERMANN (HERMANNUS), Paul (1646-1695). Rose, H. J., New Gen. Biog. Dict. 8:293, 1850.
- L'HERMINIER, Félix Louis (1779-1833). *A.*, Ann. Soc. Ent. France 2 (Bull.):lxxix-lxxx, 1833.
- HERMS, William Brodbeck (1876-1949). *A.*, Mosquito News 4:38, 46, 1944; Cattell, J., Amer. Men of Science pp. 793-794, 1944; Furman, D. P., Pan-Pacific Ent. 25:192, 1949.
- HERNANDEZ, Francisco Garcia (1514-1578). Rose, H. J., New Gen. Biog. Dict. 8:295, 1850.
- HEROLD, Hans (1877-1937). *A.*, Carinthia II, 128:135-136, 1938.
- HERRERO, Paulino J. (1865-1941). del Cañizo, J., P., Bol. Patol. Veg. y Ent. Agr. 10:367-368, 1941.
- HERRICH-SCHAEFFER, Gottlieb August Wilhelm (1799-1874). Saunders, S. S., Trans. Ent. Soc. Lond. (Proc.):xxxv, 1874.
- HERZ, Alfred Otto (1853-1905). Kusnezov, N. J., B., P., Ann. Mus. Zool. Acad. Sci. (St. Petersburg.) 11:i-iv, 1906.
- HETSCHKO, Alfred (1854-1933). Horn, W., P., Ent. Nachrichtenblatt 7:35-36, 1933.
- HEWITT, Charles Gordon (1885-1920). *A.*, Bull. N. Y. Zool. Soc. 23:6, 1920; *A.*, Ent. Record 32:170, 1920.
- HEYDEN, Carl Heinrich Georg von (1793-1866). Ratzeburg, J. T. C. Forstwissenschaftliches Schriftsteller-Lexikon pp. 239-240, 1874.
- HEYDEN, Lucas Friedrich Julius Dominicus von (1838-1915). Reitter, E., P., Ent. Mitteil. 4:253-267, 1915; *A.*, Ent. News 27:383, 1916; Csiki, E., Rovartani Lapok 23:28-29, 1916; *A.*, Bol. R. Soc. Españ. H. N. 15:422, 1915.
- HEYER, Johann Franz Christian (1777-1864). Oltrogge, C., Jahresh. Nat. Ver. Lüneburg 4:40-46, 1868-69; Ratzeburg, J. T. C. Forstwissenschaftliches Schriftsteller-Lexikon p. 240 (footnote), 1874.
- HEYMONS, Richard (1867-1943). Sachtleben, H., Arb. Phys. Angew. Ent. Berlin-Dahlem 10:259, 1943; *A.*, Zool. Anzeiger 144:208, 1944; *A.*, Arb. Morph. Taxon. Ent. Berlin-Dahlem 4:240, 1937; *A.*, P., Ztschr. Angew. Ent. 24:655, 1938.
- HICKS, Charles Henry (-1941). Osborn, H., Fragments Ent. Hist. 2:90, 1946.
- HIERONYMUS, George Hans Emo Wolfgang (1846-1921). Trotter, A., Marcellia 19:xxxv, 1920.
- HILL, John (1716-1775). Rose, H. J., New Gen. Biog. Dict. 8:321-322, 1850.
- HILLER, Reinhold (-1903). Kraatz, G., Deutsche Ent. Ztschr. 48:7, 1904.
- HILLER, Robert (-1941). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:65, 1942.
- HINDS, Warren Elmer (1876-1936). *A.*, Mass. State Coll. Fernald Club. Yearbook 6:1-2, 1937.
- HIRST, Arthur Stanley (1883-1930). "W. T. C." Nature 125:899, 1930; *A.*, Science 72:7, 1930; Bonnet, P., Bibliographia Araneorum p. 66, 1945.
- HISLOP, Robert (1815-1880). *A.* Scottish Nat. 5:331, 1879-80.
- HOBSON, R. P. (-). Thomas, I., Nature 147:739, 1941.
- HOCHHUTH, Johann Heinrich (-1872). Marseul, S. A. de, *B.* only, L'Abeille 24 (Les Ent. et leurs Écrits):192, 1887.
- HOCKEN, Melville (1888-1949). Morley, C., Nature 163:792, 1949.
- HODGKINSON, James B. (1823-1897). Trimen, R., Trans. Ent. Soc. Lond. (Proc.):lxi, 1897; *A.*, Ent. Record 9:125-127, 1897; *A.*, Ent. Mo. Mag. 33:93-94, 1897.
- HODGSON, Gerald George (1861-1911). Chapman, T. A., Ent. Record 23:76, 1911;

- A., Ent. Mo. Mag. 47:72-73, 1911; "S. W.," Entomologist 44:120, 1911.
- HÖLLMER, Franz (1820-1885). Westhoff, F., Jahresh. Westfäl. Prov.-Ver Wiss. Kunst 4:5-6, 1885.
- HOFFMAN, William Albert (1894-1943). Rozeboom, L. E., P., Journ. Parasitol. 29:301-302, 1943; Osborn, H., Fragments Ent. Hist. 2:91, 1946.
- HOFFMANN, Carlos Christian (1876-1942). Vasquez, L., Ann. Ent. Soc. Amer. 36:151-152, 1943; Ochoterena, I., P., Anal. Inst. Biol. (Mex.) 13:723, 1942; Vasquez, L., P., Rev. Med. Trop. y Parasit., Bact., Clin. y Lab (Cuba) 9:49, 1943; Osborn, H., Fragments Ent. Hist. 2:91, 1946.
- HOFFMANN, Heinrich Carl Hermann (1819-1891). Ratzeburg, J. T. C., B., Forstwissenschaftliches Schriftsteller-Lexikon pp. 247-248, 1874.
- HOFFMANN, Paul (1850-1920). Calies, G., Internat. Ent. Ztschr. 15:185-188, 1922.
- HOFFMANN, R. Wolfgang (-1940). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:134, 1942.
- HOFFMANSEGG, Johann Centurius (1766-1849). Lichtenstein, H., Protokoll Ges. Natur. u. Heilk. Dresden 1849 pp. 5-9, 1850; Dresdener Album von Elfriede von Mühlentfels Berlin pp. 24-44, 1856.
- HOFFMAN, Karl (-1926). Ochs, G., Ent. Blätter 22:192, 1926.
- HOFFMANN, Christoph (1907-1942). Escherich, K., B., P., Ztschr. Angew. Ent. 30:153-156, 1943; Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 9:284, 1942.
- HOFMANN, Ernst (-1892). Mik, J., Wiener Ent. Zeit. 11:120, 1892; A., P., Insekten-Börse, 9(5):unpaged, 1892; Hofman, O., B., Deutsche Ent. Ztschr., Iris 5:459-463, 1892.
- HOFFMANN, Ottmar (1835-1900). Escherich, K., B., P., Illustr. Ztschr. Ent. 5:140-143, 1900; A., P., Insekten-Börse 17:89, 1900; Grote, A. R., Can. Ent. 32:118, 1900; A., Ent. Record 12:109-110, 1900; Verrall, G. H., Trans. Ent. Soc. Lond. (Proc.):xlv, 1900.
- HOGG, Henry Roughton (1850-1923). Bonnet, P., Bibliographia Araneorum p. 51, 1945.
- HOLLAND, William Jacob (1848-1932). Van Duzee, E. P., Pan-Pacific Ent. 9:8, 1933; A., P., Anal. Inst. Biol. (Mex.) 3:399, 1932; Remington, J. E., Lepidopterists' News 1:98, 1947.
- HOLLAR (HOLLARD), Wenzel (1607-1677). Rose, H. J., New Gen. Biog. Dict. 8:347-348, 1850.
- HOLMBERG, Eduardo Ladislao (1852-1937). Bonnet, P., P., Bibliographia Araneorum pp. 46-47, 1945.
- HOLSTEBROE, Hertz Otto (1857-1940). West, A., P., Ent. Meddelelser 22:276-277, 1942.
- HOMBERG, William (1652-1715). Rose, H. J., New Gen. Biog. Dict. 8:353, 1850.
- HOME, Everard (1736-1832). Rose, H. J., New Gen. Biog. Dict. 8:355, 1850.
- HOMMEYER, Alexander von (1834-1903). A., Insekten-Börse 20:266, 1903; Pagenstecher, A., Jahrb. Nassau. Ver. Naturk. 57:xiii, 1904.
- HONRATH, Eduard G. (1837-1893). Dönitz, W., Berliner Ent. Ztschr. 39:319-320, 1894; A., P., Insekten-Börse 10:81, 1893.
- HOOKE, Robert (1635-1702). Rose, H. J., New Gen. Biog. Dict. 8:363-364, 1850.
- HOPE, Frederick William (1797-1862). Smith, F., Trans. Ent. Soc. Lond. (3) 1 (Proc.):117, 1862-64.
- HOPFFER, Carl Heinrich (1810-1876). Westwood, J. O., Trans. Ent. Soc. Lond. (Proc.):xlv, 1876.
- HOPFFGARTEN, Georg Maximilian von (1825-1904). A., P., Insekten-Börse 22:1, 1905; Hubenthal, W., Wiener Ent. Zeitung 24:97-98, 1905; A., Miscellanea Ent. 13:16, 1905; Daniel K., Münchener Koleopt. Ztschr. 2:390, 1906.
- HOPKINS, Andrew Delmar (1857-1948). A., USDA 8(6):4, 1949; Snyder, T. E., et al., P., Journ. Econ. Ent. 42:868-869, 1949; Snyder, T. E., et al., P., Journ. Econ. Ent. 16:413-420, 1923; Rohwer, S. A., P., Proc. Ent. Soc. Wash. 52:21-26, 1950.
- HOPLEY, Edward William John (-1869). A., Ent. Mo. Mag. 6:18, 1869.
- HOPPING, Ralph (1868-1941). Osborn, H., Fragments Ent. Hist. 2:91, 1946; Leech, H. B., Coleopterists' Bull. 2:56-57, 1940.
- HORKEL, Johann (1769-1846). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 251-254, 1874.

- HORN, George Henry (1840-1897). *A.*, Ent. Mo. Mag. 34:43-44, 1898; Arnett, R. H., Jr., Coleopterists' Bull. 1:57-58, 1947.
- HORN, Walther (1871-1939). Natvig, L. R., Norsk Ent. Tidsskrift 6:46-47, 1941; Heikertinger, F., Koleopt. Rundschau 25:204-206, 1939; *A.*, Zool. Bericht. 53:65, 1942; Birabén, M., *P.*, Rev. Mus. La Plata, Secc. Official:133-134, 1939 (1940); Hellén, W., Notulae Ent. 23:59, 1943; Korschefsky, R., *P.*, Ent. Blätter 35:177-184, 1938; Hase, A., *P.*, Anzeiger f. Schädlingssk. 15:95-96, 1939; Avinoff, A., *P.*, Ann. Ent. Soc. Amer. 32:661-663, 1939; de Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 60:(2), 1940; Porter, C. E., *P.*, Rev. Univ. Santiago 25(3):35-37, 1940; Natvig, L. R., Norsk Ent. Tidsskrift 3:3, 1932; Osborn, H., Fragments Ent. Hist. 2:91-92, 1946.
- HORNE, Charles (1824-1872). *A.*, Ent. Mo. Mag. 8:295, 1872.
- HORNER, Arthur Claypon (-1893). *A.*, Ent. Mo. Mag. 29:240, 1893; Elwes, H. J., Trans. Ent. Soc. Lond. (Proc.):lvi, 1893.
- HORNIG, Johann von (1819-1886). Bourgeois, J., Ann. Soc. Ent. France (6) 6 (Bull.):clxxvii, 1886.
- HORSFIELD, Thomas (1773-1859). Gray, J. E., Trans. Ent. Soc. Lond. n. s. 5:94-96, 1858-61.
- HORVATH, Geza de (1847-1937). China, W. E., Nature 141:1129, 1938; *A.*, Termes Közlöny (Hungary) 69:513, 1937; Lundblad, O., *P.*, Ent. Tidsskrift 69:5-7, 1948; Torre-Bueno, J. R. de la, Bull. Bklyn. Ent. Soc. 43:151-152, 1948; Lindberg, H., Notulae Ent. 18:72-73, 1938.
- HOVARD, Clodomir Antony Vincent (1873-1943). Chevalier, A., C. R. Acad. Sci. Paris 218:130-131, 1944; Maresquellé, H. J., *P.*, Bull. Soc. Bot. France 91:14-15, 1944; Trotter, A., et al., *P.*, Marcellia 30:252-268, 1948; Vaysière, P., Bull. Soc. Ent. France 48:142, 1943.
- HOUGHTON, Albert (-1897). Moberly, J. C., Ent. Record 9:124-125, 1897.
- HOULBERT, Constant Vincent (1857-1947). Jolivet, P., *B.*, *P.*, Miscellanea Ent. 45:103-108, 1948.
- HOUSER, John Samuel (1881-1947). Parks, T. H., *P.*, Journ. Econ. Ent. 40:611-613, 1947.
- HOUSKA, Jaroslav (1885-1946). Heyrovsky, L., *P.*, Acta Soc. Ent. Cechosl. 46:74-76, 1949.
- HOWARD, Charles Walter (1882-1928). Riley, W. A., Can. Ent. 60:101-102, 1928.
- HOWES, William George (1879-1946). Miller, D., *B.*, *P.*, Trans. & Proc. Roy. Soc. N. Z. 76:262-263, 1946.
- HOY, Philo Romaine (1816-1892). Schorger, A. W., *B.*, *P.*, Passenger Pigeon 6:55-59, 1944; *A.*, Auk 10:95-96, 1893; *A.*, Insect Life 5:286, 1893; *A.*, Ann. Rpt. Smithsonian. Inst. 9:88, 1854; *A.*, *I. c.* pp. 431-438, 1864; *A.*, Nat. Cyclop. 15:196, 1916; Birge, E. A., Trans. Wisc. Acad. Sci. 20:711-714, 1921.
- HUARD, Victor A. (1853-1929). Maheux, G., *P.*, Nat. Canadien 57:5-10, 1930.
- HUBBARD, George E. (-1895). Davis, J. J., Proc. Indiana Acad. Sci. 41:55, 1931.
- HUBER, Franz (1750-1831). Pellett, K. L., *P.*, Amer. Bee Journ. 69:182-184, 1929; *A.*, *P.*, L'Apicoltore 9:297-300, 1876; Rose, H. J., New Gen. Biog. Dict. 8:398, 1850.
- HUDAK, Ede Agost (1822-1902). Aigner-Abafi, L., *P.*, Rovartani Lapok 9:131-133; 9(7):13, 1902.
- HUDSON, George Vernon (1867-1946). "J. T. S." *P.*, Trans. & Proc. Roy. Soc. N. Z. 76:264-266, 1946.
- HÜBNER, Jacob (1761-1826). Griffin, F. J., Proc. Roy. Ent. Soc. Lond. 16:49-54, 1941; Lizer y Trelles, C. A., Curso de Entomologia 1:11, 1947.
- HÜBNER, Johann Gottfried (1746-1812). Germar, Mag. der Ent. 1(1):140, 1813.
- HUEMER, Hans (1858-1935). Müller, L., Ztschr. Österr. Ent.-Ver. 20:45-47, 1935.
- HUFELAND, Christoph Wilhelm (1762-1836). Rose, H. J., New Gen. Biog. Dict. 8:401, 1850.
- HUFNAGEL, Georg (1545-1600). Rose, H. J., New Gen. Biog. Dict. 8:401, 1850.
- HUGHES, Griffith (-). Rose, H. J., New Gen. Biog. Dict. 8:403, 1850.
- HUKKINEN, Yrjö Amas (1886-1946). Vappula, N. A., *B.*, *P.*, Ann. Ent. Fenn. 12:1-6, 161-172, 1946; Kamervo, V., Mem. Soc. Fauna Flor. Fenn. 23:240-241, 1946.

- HULKONEN, Olavi (1905-1937). Horn, W., Arb. Phys. Angew. Ent. Berlin-Dahlem 4:159, 1937.
- HULL, John B. (1906-1949). Dove, W. E., Journ. Econ. Ent. 42:869, 1949.
- HULST, George Duryea (1846-1900). A., Can. Ent. 32:369, 1900; A., P., Insekten-Börse 18:9, 1901; Weeks, A. C., et al., B., Journ. N. Y. Ent. Soc. 8:248-254, 1900; Meiners, E. P., P., Lepidopterists' News 2:66, 1948.
- HULTGREN, Johan Albert (1845-1938). Kemner, N. A., P., Opuscula Ent. 4:111, 1939.
- HUMBOLDT, Friedrich Heinrich Alexander (1769-1859). Lipschitz, S. J., P., Bull. Soc. Nat. Moscou, Sect. Biol., n. s. 47:420-421, 1938; Ratzeburg, J. T. C., Forst-wissenschaftliches Schriftsteller-Lexikon pp. 254-264, 1874; Lleras, J. A., B., P., Rev. Acad. Colomb. de Cienc. 3:182-186, 1939; von Baer, C. E., Bull. Classe Physico-Math. Acad. Imp. Sci. St. Petersburg 17:528-531, 1859; von Hagen, V. W., Green World of the Naturalists pp. 145-164, 1948.
- HUNTER, John (1728-1793). Rose, H. J., New Gen. Biog. Dict. 8:413-414, 1850.
- HUTCHINGS, Clarence Basden (1877-1945). Gibson, A., B., Can. Ent. 77:235-236, 1946.
- HUTCHINSON, Claud Mackenzie (-1941). Butler, E. J., Nature 148:367, 1941.
- HUTCHINSON, Emma Sarah (1820-1905). Bankes, E. R., Ent. Mo. Mag. 42:43, 274-275, 1906; A., Ent. Record 18:56, 1906.
- HUTTON, Frederick Wollaston (1836-1905). A., Ent. Mo. Mag. 42:67, 1906; Horn, W., Deutsche Ent. Ztschr. p. 12, 1906; "H. B. W.," Nature 73:32-33, 1905; A., P., Trans. N. Z. Inst. 38:v-vii, 1905; Merrifield, F., Trans. Ent. Soc. Lond. (Proc.):cxiii, 1906.
- HUXLEY, Thomas Henry (1825-1895). A., Ent. Record 7:24, 1895; Meldola, R., Trans. Ent. Soc. Lond. (Proc.):lxxi, 1895.
- IHERING, Hermann von (1850-1930). A., Physis 4:624-625, 1919; Chiarelli, A., P., Physis 10:339-342, 1931; Brandenburger, C., P., Deutsch. Ver. f. Wiss. & Kunst S. Paulo 1:1-15, 1920; Lizer y Trelles, C. A., Curso de Entomologia 1:20, 1947.
- IHERING, Rodolpho Theodore Gaspar Wilhelm von (1883-1939). Pereira, C., B., P., Arq. Zool. Est. de S. Paulo 1:491-502, 1940; Pereira, C., B., P., Rev. Mus. Paulista 24:491-502, 1940; Lizer y Trelles, C. A., Curso de Entomologia 1:23, 1947.
- ILLIDGE, Rowland (1846-1929). "G. A. W.," Australian Zool. 6:108, 1929.
- ILLIGER, Johann Carl Wilhelm (1775-1815). Marseul, S. A. de, B. only, L'Abeille 24 (Les Ent. et leurs Ecrits):188-190, 1887; Lizer y Trelles, C. A., Curso de Entomologia 1:10, 1947.
- ILTSCHIEV (ILCHEV), Dielcho (1885-1925). Buresch, I., B., P., Mitt. Bulgar. Ent. Ges. 2:3-21, 1925.
- IMHOF, Othmar Emil (1855-1936). Schinz, H., Vierteljahrschr. Naturf. Ges. Zürich 82:472-474, 1937.
- IMHOFF, Ludwig (1801-1868). Müller, A., Ent. Mo. Mag. 5:150-152, 1868; Bischof-Ehinger, A., B., Mitt. Schweiz. Ent. Ges. 3:73-81, 1872; Rüttimeyer, L., Verh. Naturf. Ges. Basel 5:353-367, 1869; Rüttimeyer, L., Verh. Schweiz. Nat. Ges. 52:229-240, 1868.
- IMMS, Augustus Daniell (1880-1949). A., Ent. News 60:45, 1949; A., Journ. Econ. Ent. 42:571, 1949; Thompson, W. R., Canadian Ent. 81:315, 1949; Tuxen, S. L., P., Ent. Meddelelser 25:350, 1949.
- INCHBALD, Peter (1815-1896). A., Ent. Mo. Mag. 32:164, 1896.
- INGLIS, James Dahleish (1909-1933). Gregson, J. D., P., Proc. Ent. Soc. Br. Columbia 44:35-36, 1947.
- INGPEN, Abel (1796-1854). Newman, E., Trans. Ent. Soc. Lond., n. s. 3 (Proc.):50-51, 1854; A., Proc. Linn. Soc. Lond. 2:425-426, 1855.
- INNES, Walter Francis (1858-1937). A., P., Bull. Soc. Roy. Ent. Egypte 21:173-174, 1937.
- ISAAK, Juliusz (1870-1924). Eichler, W., Polskie Pismo Ent. 2:157-158, 1923.
- ISENSCHMID, H. Moritz (-1879). A., Naturae Novitates 1:57, 1879; Kraatz, G., Deutsche Ent. Ztschr. 23:21, 1879.

- ISIDORUS, Bishop of Seville (c. 570-636). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insecten*. p. 15, 1836.
- ISLEY, Frederick B. (1873-1947). Alexander, G., *Ent. News* 60:29-30, 1949.
- ISSEL, Raffaele (1878-1936). A., *Bol. Soc. Ent. Ital.* 68:121, 1936; Biran, A., B., P., *Ann. Mus. Civ. Stor. Nat. Genova* 59:(13)-(23), 1935-37; Remotti, E., B., P., *Riv. Biol. (Firenze)* 22:535-546, 1937.
- IZQUIERDO, Vicente (1850-1926). Lizer y Trelles, C. A., *Curso de Entomologia* 1:25, 1947.
- JAAP, Otto (1864-1922). Hedicke, H., B., *Deutsche Ent. Ztschr.* pp. 241-242, 1922.
- JABLONOWSKI, Josef (1863-1943). Escherich, K., *Ztschr. Angew. Ent.* 30:492-494, 1944; Sachtleben, H., *Arbs. Phys. Angew. Ent. Berlin-Dahlem* 11:158, 1944.
- JACKSON, Arthur Randell (1877-1944). Dallman, A. A., et al., B., P., *Northwestern Nat.* 19:182-192, 1944; Bonnet, P., P., *Bibliographia Araneorum* p. 65, 1945.
- JACKSON, George (-1899). Dutton, R., *Naturalist (Lond.)* p. 288, 1899.
- JACOBÆUS, Oligerius (1650-1701). Rose, H. J., *New Gen. Biog. Dict.* 8:469, 1850.
- JACOBS, Jean Charles (1821-1907). Fologne, E., P., *Mem. Soc. Ent. Belg.* 15:1-5, 1908.
- JACOBSON, Edward (1870-1944). De Meijere, J. C. H., B., P., *Ent. Berichten* 12:2-4, 1946.
- JACOBSON, Helmut (1914-1942). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 10:174-175, 1943.
- JACOT, Arthur Paul (1890-1939). Osborn, H., *Fragments Ent. Hist.* 2:92, 1946.
- JACQUELIN DU VAL, Pierre Nicolas Camille (1828-1862). Migneux, J., *Ann. Soc. Ent. France* (4) 2:617-619, 1862; Marseul, S. A., *L'Abeille* 24 (Les Ent. et leurs Écrits):177-179, 1887.
- JACQUIN, Nicholas Joseph (1727-1817). Rose, H. J., *New Gen. Biog. Dict.* 8:473, 1850.
- JÄGERSKIÖLD, L. A. (-1945). Lundblad, O., P., *Ent. Tidskrift* 66:155-156, 1945.
- JÄNICHEN, Robert (-1912). Belling, *Internat. Ent. Ztschr.* 6:204, 1912.
- JAFFUEL, Félix (1874-1939). Lizer y Trelles, C. A., *Curso de Entomologia* 1:27, 1947.
- JANDER, Albert (1840-1920). Hedwig, K., *Jahresh. Ver. Schles. Insekten. Breslau* 13:21-23, 1921.
- JANSON, Edward Wesley (1822-1891). Godman, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:xliv-1, 1891; A., P., *Insekten-Börse* 8 (21):unpaged, 1891; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 270, 1874.
- JAROSCHEWSKY, Vasilii Alexisevich (1841-1901). Schewyrew, J., B., *Rev. Russe Ent.* 1:70-71, 1901.
- JAROSLAV, Novák (-1938). Vimmler, A., *Acta Soc. Ent. Cechoslov.* 35:82, 1938.
- JEFFERY, Hugh Geoffrey (-1948). Blair, K. G., *Ent. Mo. Mag.* 84:48, 1948; Wakely, S., *Ent. Record* 60:68, 1948.
- JEFFREY, William Rickman (1836-1912). Turner, H. J., *Ent. Record* 24:279-280, 1912; Porritt, G. T., *Ent. Mo. Mag.* 48:288, 1912; Porritt, G. T., *l. c.* 49:38, 1913.
- JENNISON, Harry Milliken (1885-1940). A., *Mass. State Coll. Fernald Club. Year-book* 10:42-43, 1941.
- JENSEN, Otto Gordius (1833-1905). Engelhart, C., P., *Ent. Meddelelser* 12:20, 1918.
- JENYN, Leonard (See under *Blomefield*, Leonard).
- JESTER, Friedrich Ernst (1743-1822). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 270-272, 1874.
- JOANNIS, Joseph de (1854-1932). Viette, P. E., P., *Lepidopterists' News* 3:77, 1949.
- JÖKER, Astrid (1883-1946). Larsson, S. G., B., *Ent. Meddelelser* 25:149, 1947.
- JOHANSEN, Johan Peter (1844-1915). Engelhart, C., *Ent. Meddelelser* 10:337-338, 1915; Engelhart, C., P., *l. c.* 12:18-19, 1918.
- JOHNSON, Charles Willison (1863-1932). Melander, A. L., B., *only, Psyche* 39:87-99, 1932.
- JOHNSON, Orson Bennett (1848-1917). Hatch, M. H., P., *Century of Ent. in Pacific Northwest* pp. 5-6, 1949.
- JOHNSON, William Frederick (1852-1934). Walker, J. J., *Ent. Mo. Mag.* 70:164-165, 1934.
- JOHNSTON, Frederick Andrew (1887-1941). A., *Mass. State Coll. Fernald Club Year-book* 11:35-36, 1942; A., U. S. Dept. Agr. Bur. Ent. & Plant Quar. *News Letter* 8(2):1, 1941.

- JONES, Albert Hugh (-1924). *A.*, Amer. Journ. Sci. (5) 7:440, 1924.
- JONES, Thomas Henry (1885-1941). *A.*, Mass. State Coll. Fernald Club Yearbook 11:36-37, 1942; *A.*, U. S. Dept. Agr. Bur. Ent. & Plant Quar. News Letter 8(3):1, 1941; Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 9:55, 1942; Osborn, H., Fragments Ent. Hist. 2:92-93, 1946.
- JONSTON, John (1603-1675). Eiselt, J. N., Geschichte, Systematik und Literatur der Insectenk. p. 20, 1836.
- JORDAN, Robert Coane Roberts (1825-1890). *A.*, Ent. Mo. Mag. 26:195-196, 1890; Tutt, J. W., Ent. Record 1:97, 1890; Warren, W., *B.*, Entomologist 23:238-240, 1890.
- JORDIS, Carl (-1903). *A.*, Insekten-Börse 20:338, 1903; *A.*, Societas Ent. 18:109, 1903.
- JOUKL, Hans A. (1862-1910). Kheil, N. M., Internat. Ent. Ztschr. 4:243-244, 1911; Klapálek, F., Acta Soc. Ent. Bohemiae 7:128-129, 1910; *A.*, Deutsche Ent. Nat.-Bibliothek 2:40, 1911.
- JUAN Y SANCTACILIA, Don Jorge (1713-1773). Rose, H. J., New Gen. Biog. Dict. 9:53, 1850.
- JUDAY, Chancey (1871-1944). Noland, L. E., et al., *B.*, Limnol. Soc. Amer. Spec. Pub. no. 16, pp. 1-9, 1945.
- JUDEICH, Johann Friedrich (1828-1894). *A.*, Insekten-Börse 11:79, 1894, 1894; *A.*, Wiener Ent. Zeit. 13:195, 1894; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 273-274, 1874.
- JULLIEN, John (1873-1928). Pictet, A., *B.*, P., Bull. Soc. Lepidopt. Genève 6:17-18, 45-62, 1928.
- JUNIUS, Hadrianus (1511-1575). Rose, H. J., New Gen. Biog. Dict. 9:63-64, 1850.
- JUNK, Wilhelm (1866-1942). *A.*, Ent. News 55:215, 1944; Riley, N. D., Proc. Roy. Ent. Soc. Lond. (C) 9(5):19, 1944; Reitter, E., Ent. Nachrichtenbl. 10:148-149, 1936; *A.*, Bol. Soc. Ent. Ital. 68:33, 1936.
- JUREČEK, Stěpán (1877-1940). Obenberger, J., *P.*, Acta Soc. Ent. Bohemiae 37:1-2, 1940.
- JURINE, Louis (1751-1819). Eiselt, J. N., Geschichte, Systematik und Literatur der Insectenk. pp. 105-108, 1836.
- JUSTELL, Henri (1620-1693). Rose, H. J., New Gen. Biog. Dict. 9:68, 1850.
- JUSTI, Johann Heinrich Gotlob von (-1771). Rose, H. J., New Gen. Biog. Dict. 9:68, 1850.
- KAEMPFER, Engelbert (1651-1716). Rose, H. J., New Gen. Biog. Dict. 9:73-74, 1850.
- KAESTNER, Abraham Gotthelf (1719-1800). Rose, H. J., New Gen. Biog. Dict. 9:74, 1850.
- KAHL, Paul Hugo Isidor (1859-1941). Osborn, H., *P.*, Fragments Ent. Hist. 2:93-94, 1946.
- KALIS, Jorinus Pieter Adrianus (1899-1949). Roepke, W., *P.*, Ent. Berichten 12:425-427, 1949.
- KALM, Pehr (1715-1779). Rose, H. J., New Gen. Biog. Dict. 9:76, 1850; Brendel, F., American Nat. 13:755-756, 1879.
- KALTENBACH, Johann Heinrich (1807-1876). *A.*, Ent. Nachrichten 2:112-114, 1876.
- KAMBERSKY, Otto (1859-1907). *A.*, Ent. Zeitschrift 21:196, 1907; Reitter, E., Wiener Ent. Zeit. 26:325-326, 1907.
- KANE, William Francis de Vismes (1840-1918). Edwards, S., Proc. So. Lond. Ent. & N. H. Soc. p. 36, 1918-19; *A.*, Ent. Record 30:157, 1918.
- KANERVA, Nilo (1898-1942). Kivirikko, E., *P.*, Ann. Ent. Fennici 9:1-3, 1943.
- KARNY, Heinrich Hugo (1886-1939). Heikertinger, F., Koleopt. Rundschau 25:206, 1939; Carpenter, F., Bull. & Ann. Soc. Ent. Belg. 79:399, 1939; *A.*, Norsk Ent. Tidsskrift 6:50-51, 1941; *A.*, Ciencia (Mex.) 1:23, 1940; de Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 60:(2)-(3), 1940.
- KARSCH, Ferdinand Anton Franz (1853-1936). Bonnet, P., *P.*, Bibliographia Araneorum pp. 48-49, 1946.
- KARSTEN, Herman Gustav Wilhelm Karl (1817-1877). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 275-279, 1874.
- KASCHKE, Karl (1852-1935). Rupp, *P.*, Ent. Rundschau 53:241-243, 1936.
- KATSUKI, Kiyoshi (-1937). *A.*, Arb. Phys. Angew. Ent. Berlin-Dahlem 5:79, 1938.

- KAUFMANN, Otto (1896-1944). Sachtleben, H., Arb. Phys. Angew. Ent. Berlin-Dahlem 11:157-158, 1944.
- KAUFMANN-JAN, Willy (-1947). Vogel, F., P., Mitt. Schweiz. Ent. Ges. 21:296-297, 1948.
- KAWALL, Johann Heinrich Carl (-1881). Kraatz, G., Deutsche Ent. Ztschr. 25:340, 1881.
- KEA, J. W., Jr. (1911-1936). Horn, W., Arb. Phys. Angew. Ent. 4:159, 1936; A., Florida Ent. 19:54, 1937.
- KEARFOTT, William Dunham (1864-1917). A., Ent. Record 30:112, 1918.
- KEELEY, R. G. (-1874). A., Ent. Mo. Mag. 11:70, 1874.
- KEFERSTEIN, Georg Adolph (1793-1884). Staudinger, O., Stettiner Ent. Zeit. 46:109-113, 1885; Kraatz, G., Deutsche Ent. Ztschr. 29:21-22, 1885.
- KELLERMAN, Karl Frederick (1879-1934). Taylor, W. A., Science 80:373-374, 1934; A., Journ. Wash. Acad. Sci. 24:460, 1934.
- KELLCOTT, David Simons (1842-1898). Bleile, A. M., P., Trans. Amer. Micro. Soc. 20:21-24, 1899.
- KELLNER, August (1794-1883). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 279-283, 1874.
- KELLOGG, Vernon Lyman (1867-1937). Doane, R. W., B., P., Ann. Ent. Soc. Amer. 33:599-607, 1940; Imms, A. D., Nature 140:610, 1937; Osborn, H., Fragments Ent. 2:94, 1946.
- KELLY, Edward Guerrant (1880-1949). A., USDA 8(6):4, 1949.
- KELSALL, Thomas (-1903). Bailey, J. H., Ent. Mo. Mag. 40:18-19, 1904; "R. J. W.," Entomologist 37:52, 1904.
- KEMNER, Nils Viktor Alarik (1887-1948). Saalas, U., P., Ann. Ent. Fennici 14:22-25, 1948; Ahlberg, O., P., Ent. Tidskrift 70:180-183, 1949; Ander, K., Opuscula Ent. 13:101-114, 1948; Tuxen, S. L., Ent. Meddelelser 25:330-331, 1949; Horion, A., Koleopt. Zeitschrift 1:159, 1949.
- KEMP, Stanley (-1945). Ashe, G. H., Ent. Mo. Mag. 81:240, 1945.
- KEMPNY, Peter (1862-1906). Morton, K. J., Ent. Mo. Mag. 42:184, 1906; A., Wiener Ent. Zeit. 26:120, 1906; Horn, W., Deutsche Ent. Ztschr. p. 13, 1906; Rebel, H., Verh. Zool.-Bot. Ges. Wien 56:613, 1906; Handlirsch, A., B., P., l. c. 58:259-263, 1908; Navas, L., B., P., Bol. Soc. Aragon. Cienc. Nat. 5:182-185, 1906.
- KENDERESSY, Dénes (1846-1881). Bordan, I., P., Rovartani Lapok 4:25-28; 4(3):3, 1897.
- KENNEL, Julius von (1854-1939). Escherich, K., P., Ztschr. Angew. Ent. 30:148-151, 1943.
- KESSLER, Hermann Friedrich (1816-1897). Ackermann, A., B., Ent. Nachrichten 13:76-78, 1889; A., Insekten-Börse 14:169, 1897; Kessler, H. F., et al., P., Abh. & Ber. Naturk. Kassel 61:77-95, 1897.
- KEYS, James H. (1855-1941). Cameron, B. M., Ent. Mo. Mag. 77:60-61, 1941.
- KEYSERLING, Eugen von (1833-1889). Bonnet, P., Bibliographia Araneorum pp. 39-40, 1945; Marx, G., Ent. Americana 5:159-160, 1889.
- KHEIL, Napoleon Manuel (1849-1923). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:182-183, 1919.
- KIDD, Henry Waring (1845-1884). A., Ent. Mo. Mag. 21:39, 1884.
- KIEFFER, Jean Jacques (1857-1925). Fleur, E., Bull. Soc. Hist. Nat. Moselle (Metz) 31:7-8, 1926; Fleur, E., et al., P., l. c. 32:7-59, 1929; Trotter, A., P., Marcellia 22:130-133, 1925.
- KIESENWETTER, Ernst August Hellmuth von (1820-1880). Marseul, S. A. de, L'Abeille 18 (Nouv. et Faits Divers (2) 31):123-124, 1880; Marseul, S. A. de, B. only l. c. 21:63-71, 1883; Westermann, G. F., Zool. Anzeiger 3:216, 1880.
- KINDERMANN, Albert, Jr. (1810-1860). Lederer, J., Wien. Ent. Monatschr. 4:251-255, 1860.
- KING, Albert Freeman Africanus (1841-1914). Howard, L. O., P., Pop. Sci. Monthly 87:175, 1915.
- KING, Edmund (-). Rose, H. J., New Gen. Biog. Dict. 9:110, 1850.
- KING, James Joseph Francis-Xavier (1855-1933). A., Ent. Mo. Mag. 69:166, 1933.
- KIRBY, William (1759-1850). Eiselt, J. N., Geschichte, Systematik und Literatur der

- Insectenk. pp. 101-105, 1836; A., Proc. Linn. Soc. Lond. 2:133-135, 1851; Freeman, J., P., Life of William Kirby, rector of Barham, London, 506 pp., 1852.
- KIRBY, William Forsell (1844-1912). Kheil, N. M., B., Internat. Ent. Ztschr. 6:251-252, 1912.
- KIRCH, Christfried (1694-1740). Rose, H. J., New Gen. Biog. Dict. 9:118, 1850.
- KIRCHER, Athanase (1602-1680). Percheron, A., Bibliographie Ent. 1:207, 1837.
- KIRCHMAIER, Georg Caspar (1635-1700). Rose, H. J., New Gen. Biog. Dict. 9:119, 1850.
- KIRKLAND, Archie Howard (1873-1931). Burgess, A. F., Mass. State Coll. Fernald Club Yearbook 10:1-3, 1941.
- KIRSTEN (KIRSTENIUS), Georg (1613-1660). Rose, H. J., New Gen. Biog. Dict. 9:120, 1850.
- KISSINGER, John B. (-1909). Horn, W., Deutsche Ent. Ztschr. pp. 583-584, 1909; A., Ent. Rundschau 26:81, 1909.
- KITTNER, Theodor (-1906). Schmeichler, L., Verh. Naturf. Ver. Brünn 45 (Sitz-Ber.):41, 1906.
- KIVIRIKKO, Kaarlo Eemeli (1870-1947). Saalas, U., P., Ann. Ent. Fennici 13:61-63, 1947.
- KLÄGER, Hermann (-1916). Ross, E., Internat. Ent. Ztschr. 27:525, 1934.
- KLAGES, Henry G. (1860-1936). Osborn, H., Fragments Ent. Hist. 2:94-95, 1946.
- KLAPÁLEK, Frantisek (1863-1919). Tábořsky, K., Sbornik Ent. Odd. Nar. Mus. Praz 12:208-219, 1934.
- KLEBS, Richard Hermann Erdmann (1850-1911). A., Ent. Zeitschrift 25:108, 1911; Tornquist, A., B., P., Schrift. Physil. Ökonom. Ges. Königsberg in Pr. 25:31-37, 1911; A., Wiener Ent. Zeit. 30:178, 1911.
- KLEE, Heinrich (1905-1943). Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 10:259-260, 1943.
- KLEEMAN, Christian Friedrich (-1789). Meissner, O., P., Ent. Zeitschrift 41:377, 1928.
- KLEIN, Jacob Theodor (1685-1759). Rose, H. J., New Gen. Biog. Dict. 9:122, 1850.
- KLEIN, Peter Adolf (1853-1889). Engelhart, C., P., Ent. Meddelelser 12:17-18, 1918.
- KLEINE, Richard (1874-1948). Sachtleben, H., P., Koleopt. Zeitschrift 1:89-92, 1949; Saalas, U., P., Ann. Ent. Fennica 15:139-140, 1949.
- KLETKE, Paul (1835-1917). A., Jahresh. Ver. Schles. Insektenk. Breslau 10-12, 22-23, 1919.
- KLIMA, Anton (1871-1941). Sachtleben, Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:65, 1942.
- KLIMSCH, Edgar (1878-1939). Puschig, R., Carinthia II 49:125, 1939.
- KLINGER, Heinz (1911-1940). Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 7:168, 1940.
- KLITSCHKA, Theodor (-1938). Guhn, A., Ent. Zeitschrift 52:317-318, 1939.
- KLUG, Johann Christoph Friedrich (1775-1856). Bell, T., Proc. Linn. Soc. Lond. 1:liv, 1857; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 165-166 (footnote) 1874; Marseul, S. A. de, B. only, L'Abeille 24 (Les Ent. et leurs Ecrits):181-186, 1887.
- KNABL, Hermann (1880-1940). Heikertinger, F., Koleopt. Rundschau 26:92, 1940; A., Ent. Blätter 36:157, 1940.
- KNATZ, Johann Ludwig (1831-1892). A., B., Ber. Ver. Naturk. Kessel 38:10, 1892; A., Leopoldina 28:163, 1892; "M." Ent. Zeitschrift 6:95, 1892.
- KNAUTH, Johannes (1843-1905). A., Insekten-Börse 22:206, 1905; A., l. c., 23:5, 26, 1906; Daniel, K., Münch. Koleopt. Ztschr. 2:394, 1906.
- KNIEPHOFF, Johannes (1865-1940). A., P., Ent. Blätter 37:93, 1941.
- KNIGHT, Hugh (1877-1943). Quayle, H. J., P., Journ. Econ. Ent. 37:330-331, 1944; Osborn, H., Fragments Ent. Hist. 2:95, 1946.
- KNIGHT, Thomas Andrew (1759-1838). Rose, H. J., New Gen. Biog. Dict. 9:126, 1850; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 139 (footnote), 1874.
- KNISCH, Alfred (1885-1926). Heikertinger, F., B., Koleopt. Rundschau 13:86-88, 1927.
- KNOCH, Julius (1828-1893). A., Leopoldina 29:162-163, 1893.
- KNÖRLEIN, Josef (1806-1883). Ross, E., Internat. Ent. Ztschr. 27:526, 1934.

- KNOTH, M. A. (1863-1937). Arb. Morph. Taxon. Ent. Berlin-Dahlem 4:160, 1937.
- KNOWLES, Robert (1883-1936). A., Journ. Parasitol. 22:550-551, 1936.
- KNOX, Robert (1638-1720). Rose, H. J., New Gen. Biog. Dict. 9:131, 1850.
- KNUTH, Paul (1854-1899). Ludwig, F., B., P., Illustr. Ztschr. Ent. 4:365-367, 1899.
- KOBERT, Eduard Rudolf (1854-1918). A., Ent. News 30:210, 1919.
- KOCH, Carl Ludwig (1778-1857). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 283-288, 1874; Bonnet, P., P., Bibliographia Araneorum p. 32, 1945.
- KOCH, Gabriel (-1881). Heyden, L. von, Ent. Monatsblätter 2:175, 1880 (1881).
- KOCH, Ludwig Carl Christian (1825-1908). Bonnet, P., P., Bibliographia Araneorum p. 38, 1945.
- KOCH, Robert (1843-1910). Libbertz, A., P., Ber. Senckenb. Naturf. Ges. 41:306-318, 1910; Schwalbe, J., P., Deutsche Med. Wochenschr. 55:1772, 1929; Kleine, F. K., Deutsche Tierärztl. Wochenschr. 48:269-271, 1940.
- KOCH, Valdemar (1852-1902). Engelhart, C., Ent. Meddelelser 12:19, 1918.
- KOEBELE, Albert (1852-1924). A., P., Arx. Escola Sup. Agr. (Barcelona) n. s. 1:187-191, 1934-35; Weigand, B., Bädische Blätter für Schadlingsbekämpfung. 1:1-3, 1923; Van Duzee, E. P., Pan-Pacific Ent. 1:191, 1925; Swezey, O., B., P., Haw. Plant. Record 47:5-8, 1943; Timberlake, P. H., et al., P., Bull. Exp. Sta. Haw. Sugar Plant. Assoc., Ent. Ser. 22:2-8, 1943.
- KOEMPFFER, Engelbert (1651-1716). Percheron, A., B., Bibliographia Ent. 1:198, 1837.
- KÖNIG, Gottlob (1779-1849). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 288-290, 1874.
- KOENIG, Samuel (1712-1757). Rose, H. J., New Gen. Biog. Dict. 9:134, 1850.
- KÖRTE, Heinrich Friedrich Franz (1782-1845). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 478 (footnote), 1874.
- KOFOID, A. C. (1874-1949). West, A., P., Ent. Meddelelser 25:331-332, 1949.
- KOLBE, Hermann Julius (1855-1939). Heikertinger, F., Koleopt. Rundschau 26:91, 1940; A., Norsk Ent. Tidsskrift 6:51, 1941; A., Insekten-Börse 17:113, 1900; Hellén, W., Notulae Ent. 23:59, 1943.
- KOLBE, Wilhelm (1852-1929). Hinke, O., B., P., Ent. Blätter 15:172-180, 1919; Heikertinger, F., et al., Koleopt. Rundschau 15:245, 1930.
- KOLLAR, Vincenz (1797-1860). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 290-291, 1874.
- KONAKOV, Nikolai Nikolaivitch (1900-1947). Grunin, K., B., P., Rev. Ent. URSS 30:168-170, 1948.
- KOONS, Benjamin Franklin (1844-1903). A., Insekten-Börse 21:130, 1904.
- KOPONEN, Juhana Samuli Valdemar (1882-1948). Valle, K. J., Ann. Ent. Fennici 14:49, 1948.
- KORB, Rosina (-1911). A., Ent. Zeitschrift 25:43, 1911.
- KRAATZ, Gustav (1831-1909). Horn, W., P., Deutsche Ent. Ztschr. pp. 109-112, 1910; A., Ent. Rundschau 26:132-133, 1909; "K. J.," Ent. Mo. Mag. 46:21-22, 1910.
- KRANCHER, Paul Oskar (1857-1936). Dorn, K., P., Ent. Blätter 33:7-8, 1937; Grabe, A. P. and poem, Ent. Jahrbuch 46:opp. 216, 1937.
- KRAUSE, Ernst (-1903). A., Insekten-Börse 20:306, 1903. (Pseudonym was Carus Sterne).
- KREKICH-STRASSOLD, Hans (1864-1929). Heikertinger, F., et al., Koleopt. Rundschau 15:245, 1930; Heberdey, R. F., B., P., l. c. 16:29-32, 1930-31.
- KREYE, Hermann (1856-1940). Sachtleben, Arb. Morph. Taxon. Ent. Berlin-Dahlem 7:76, 1940; Metzger, A., Ent. Zeitschrift 53:293-294, 1940.
- KRIECHBAUMER, Joseph (1819-1902). A., Münch. Koleopt. Ztschr. 1:116, 1902-03.
- KRIESCH, János (1834-1888). A., Math. Nat. Ber. Ungarn 6:501-503, 1887-88; Lengyel, I., Term. Közlön. (Hungary) 21:603-604, 1889.
- KRISHNA AYYAR, P. N. (1894-1946). Lal, K. B., P., Indian Journ. Ent. 8:137-138, 1947.
- KRÜGER, Giorgio (1871-1940). De Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 61:(2)-(3), 1943; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 10:174, 1943.
- KRUTZSCH, Karl Lebrecht (1772-1852). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 274 (footnote), 1874.

- KUDLIČKA, Eduard (1866-1940). Heyrovsky, L., P., *Acta Soc. Ent. Bohemiae* 37:81-82, 1940.
- KÜHN, Heinrich (1860-1906). A., *Insekten-Börse* 23:127, 1906; Horn, W., *Deutsche Ent. Ztschr.* p. 13, 1906; Hartert, E., *Novitates Zool.* 14:340-341, 1907.
- KÜNCKEL D'HERCULAIS, Jules Philippe Alexandre (1843-1918). Lizer y Trelles, C. A., *Curso de Entomologia* 1:32-33, 1947; A., (false rumor), *Insect Life* 4:156, 1892.
- KÜNNEMANN, Georg (1866-1922). Fiedler, C., *Ent. Blätter* 19:97-101, 1923; Ross, E., *Internat. Ent. Ztschr.* 27:527-528, 1934.
- KÜNOW, Gotthold (1840-1909). A., *Ent. Rundschau* 26:39, 1909; Horn, W., *Deutsche Ent. Ztschr.* pp. 468-468, 1909.
- KÜSTER, Heinrich Carl (1807-1876). A., *Ent. Nachrichten* 2:112, 1876.
- KUHLMANN, Ludwig (1857-1928). Seitz, A., *Ent. Rundschau* 45:17, 1928.
- KUHNT, Paul (-1934). Ross, E., *Internat. Ent. Ztschr.* 27:526-527, 1934.
- KULAGIN, Nikolai Michailowitsch (1860-1940). Sachtleben, H., *Arb. Phys. Angew. Ent. Berlin-Dahlem* 7:169, 1940; Bozdanov-Katkov, N. N., P., *Bull. Plant Protection (Russia)* 1:2-3:7, 1940.
- KULCZYNSKI, Wladyslaw (László) (1854-1919). Bonnet, P., P., *Bibliographia Araneorum* pp. 42-43, 1945.
- KUNTZE, Heinrich (1838-1900). Dittrich, R., *Ztschr. f. Ent. (Breslau)* 25:27-28, 1900.
- KUNTZE, Roman (1902-1944). Kapuscinski, S., B., P., *Polskie Pismo Ent.* 18:129-141, 1939-48.
- KUNZE, Gustav (1793-1851). Westwood, J. O., *Trans. Ent. Soc. Lond. n. s.* 1 (Proc.):137, 1850-51.
- KUSCHE, J. (-1934). A., *Pan-Pacific Ent.* 10:26, 1934.
- KUSNEZOV, Nikolai Jakoblevich (1873-1948). A., *Lepidopterists' News* 2:110, 1948; Borodin, D. N., B., P., *l. c.* 3:29-31, 1949; Burr, M., *Ent. Record* 60:102, 1948.
- KUSNEZOV, Victor N. (-1932). Horn, W., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 1:309, 1934.
- KUWERT, August Ferdinand (1828-1894). Barthe, E., *Miscellanea Ent.* 2:108-109, 1894; A., *Insekten-Börse* 11:191-192, 1894; Speiser, B., P., *Schrift. Phys.-Oekon. Ges. Königsberg* 67(1):91-94, 1930.
- LABOISSIÈRE, Victor (1875-1942). Jolivet, P., B., P., *Miscellanea Ent.* 45:113-117, 1948. (P.) to appear in next number.
- LABOULBÈNE, Jean Joseph Alexandre (1825-1898). Bouvier, E. L., *Bull. Soc. Ent. France* p. 341, 1898.
- LABREY, Beebe Bowman (1817-1882). A., *Ent. Mo. Mag.* 19:22, 1882.
- LACAZE-DUTHIERS, Félix Josef Henri de (1821-1901). "S. F. H.," *Proc. Roy. Soc. Lond.* 75:146-150, 1904-05.
- LACÈNE, Antoine Marie Étienne (1769-1859). Mulsant, E., B., P., *Opusculs Ent.* 12:20127, 1860.
- LACKSCHEWITZ, Paul (1865-1936). "L. R. M.," *Norsk Ent. Tidsskrift* 4:136, 1936; Knorre, H. von, B., P., *Korrespondenzbl. Naturf.-Ver. Riga* 62:20-29, 1937.
- LACORDAIRE, Jean Theodore (1801-1870). Marseul, S. A. de, B. only, *L'Abeille* 20 (Les Ent. et leurs Ecrits):11-14, 1882.
- LACROIX, J. G. L. (-1939). A., *Lambillionea* 39:141, 1939.
- LAET, Joannes de (1593-1649). Rose, H. J., *New Gen. Biog. Dict.* 9:153, 1850.
- LAFFERTÉ-SÉNÉCTÈRE, F. Thibault de la Carte (1808-1886). Bourgeois, J., *Ann. Soc. Ent. France* (6) 6 (Bull.):lxvii, 1886; Marseul, S. A. de, B. only *L'Abeille* 24 (Les Ent. et leurs Ecrits):173-174, 1887.
- LAHILLE, Fernando (1861-1940). Joan, T., P., *Gaceta Veterinaria* 4(17):2 pp. (unpagged), 1942; Porter, C. E., B., P., *Rev. Chilena Hist. Nat.* 44:266-268, 1940; Lizer y Trelles, C. A., *Curso de Entomologia* 1:38-39, 1947; Fesquet, A. E. J., B., P., *Rev. Soc. Ent. Arg.* 10:379-393, 1940; Porter, C. E., *l. c.* 10:451-452, 1940.
- LAMARCK, Jean Baptiste Pierre Antoine de Monet de (1744-1829). Weidenreich, F., P., *Ber. Senckenb. Naturf. Ges.* 60:326-333, 363-369, 1930; Cuvier, G., *Mem. Acad. Roy. Sci. Inst. France* 13:i-xxi, 1831 (1835); Eiseit, J. N., *Geschichte, Systematik und Literatur der Insectenk.* pp. 76-80, 1836; Rose, H. J., *New Gen. Biog. Dict.* 9:164-165, 1850; Beaulieu, G., *Nat. Canadien* 57:80-83, 1930; Beltran, E., *Rev. Soc. Mex. Hist. Nat.* 5:155-166, 1944; A., P., *Rev. Acad.*

- Colombiana Cienc Exactes, Fis. y Nat. 6:427-429, 1945.
- LAMB, Charles George (1867-1941). "C. R. C.," *Nature* 147:702-703, 1941.
- LAMBERT, Claude Francois (1705-1765). Rose, H. J., *New Gen. Biog. Dict.* 9:170, 1850.
- LANCEY, William (-1853). Newman, E., *Zoologist* 12:4228, 1854.
- LANG, Henry Charles (-1909). A., *Ent. Mo. Mag.* 46:39, 1910; A., *Ent. Record* 22:28, 1910; A., *Entomologist* 43:48, 1910; Horn, W., *Deutsche Ent. Ztschr.* p. 212, 1910; Dixey, F. A., *Trans. Ent. Soc. Lond. (Proc.)*:lxxxviii, 1909.
- LANGHOFFER, August (1861-1940). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 7:169-170, 1940.
- LANSBERGE, J. W. van (-1909). A., *Ent. Rundschau* 26:74, 1909; Lameere, A., *Ann. Soc. Ent. Belg.* 53:191, 1909.
- LAPOUGE, Georges Vacher de (1854-1936). A., *Miscellanea Ent.* 37:39-40, 1936; Barthe, E., B., P., *l. c.* 38:29-31, 1937.
- LARROUSSE, Fernand (1888-1937). Brumpt, E., B., P., *Ann. de Parasitol.* 15:552-556, 1937.
- LARSON, Andrew Olof (1887-1948). Campbell, R. E., et al., P., *Journ. Econ. Ent.* 42:165, 1949.
- LATASTE, Fernand (1847-1934). Porter, C. E., *Rev. Chilena Hist. Nat.* 38:53-56, 1934; Lizer y Trelles, C. A., *Curso de Entomologia* 1:25, 1947.
- LATIER, Henry J. H. (-1929). Cremers, J., P., *Natuurh. Maandblad* 18:53-54, 1929.
- LATREILLE, Pierre André (1762-1833). Silbermann, G., *Rev. Ent. (Caen)* 1:39-42, 1833; Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenk.* pp. 67-74, 1836; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 123-124 (footnote), 1874; Rose, H. J., *New Gen. Biog. Dict.* 9:205, 1850; Lesne, P., *Bull. Soc. Ent. France* pp. 230-232, 1907; Lizer y Trelles, C. A., *Curso de Entomologia* 1:11, 1947; Percheron, A., B., P., *Bibliographie Ent.* 1:225-235, 1837; Dow, R. P., *Bull. Bklyn. Ent. Soc.* 8:40, 1913; Bonnet, P., P., *Bibliographia Araneorum* p. 31, 1945.
- LATTER, Oswald H. (-1948). Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (c)* 13:69, 1948-49.
- LAURENT, Charles (1821-1870). Chevrolat, A., *Ann. Soc. Ent. France (5)* 1:119-121, 1871.
- LAURO, Christian Peter (1772-1858). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 291-295, 1874.
- LAVERAN, Alphonse (1845-1922). Franchini, G., P., *Sexta Reunión Soc. Arg. Patol. Reg. del Norte* pp. vii-xx, 1930; Howard, L. O., P., *Pop. Sci. Monthly* 87:73, 1915; "A. F.," *Riv. Biologia* 4:421, 1922; Dorland, W. A. N., P., *Clinical Med. & Surg.* 43:571-572, 1936.
- LAVERS, Charles Henry, Jr. (-1941). Lavers, A. J., *Trans. Amer. Micro. soc.* 64:228, 1945.
- LAZEAR, Jesse William (1866-1900). Howard, L. O., P., *Pop. Sci. Mo.* 87:178, 1915; Thayer, W. S., *Johns Hopkins Hosp. Bull.* 11:290-291, 1900.
- LEA, Arthur Mills (1868-1932). Osborn, T. G. B., *Proc. Linn. Soc. N. S. Wales* 57:iii, 1932; Hale, H. M., B., P., *Rec. So. Austr. Mus.* 4:411-432, 1932.
- LEA, Isaac (1792-1886). A., *Leopoldina* 23:53-54, 1887.
- LEACH, William Elford (1790-1836). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insektenk.* pp. 86-88, 1836; Rose, H. J., *New Gen. Biog. Dict.* 9:216, 1850.
- LEBEDEV, Alexander G. (1874-1936). A., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 3:151, 1936.
- LEBERT, Hermann (1813-1878). Bonnet, P., P., *Bibliographia Araneorum* p. 36, 1945.
- LE CERF, Ferdinand (1881-1945). Fletcher, T. B., *Ent. Record* 57:76, 1945; Oberthür, C., P., *Études Lép. Comp.* 10 (plates):unpaged, 1915.
- LE CONTE, John Eatton (1784-1860). Sallé, A., *Ann. Soc. Ent. France (6)* 3:571-576, 1883; Scudder, S. H., *Butterflies of E. U. S. & Canada* 1:654-656, 1889; Marseul, S. A., *L'Abeille* 22 (Les Ent. et leurs Ecrits):124, 1884.
- LE CONTE, John Lawrence (1825-1883). Marseul, S. A. de, *L'Abeille* 21 (Nouv. et Faits Divers (2) 47):185-188, 1884; Marseul, S. A., B., *l. c.* 22 (Les Ent. et

- leurs Écrits):124-136, 1884; Kraatz, G., Deutsche Ent. Ztschr. 28:240, 1884; Arnett, R. J., Jr., Coleopterists' Bull. 1:46-48, 1947.
- LEDERER, Julius (1821-1870). Weyers, J. L., Ann. Soc. Ent. Belg. 13 (C. R.):xxv-xxvi, 1869-70.
- LEE, Arthur Bolles (1849-1927). A., Nature 119:432, 1927.
- LEECH, Daniel Herbert (1878-1941). Leech, H. B., P., Proc. Ent. Soc. Br. Col. 44:36-38, 1947.
- LEESBURG, Antonius Franciscus Adolphus (1848-1906). Everts, E., P., Tijdschr. Ent. 50:117-120, 1907.
- LEEUWENHOEK, Antony van (1632-1723). Bolsius, R. P., Ann. Soc. Sci. Bruxelles 26:166-174, 1902; Rose, H. J., New Gen. Biog. Dict. 9:259-260, 1850; Percheron, A., B., Bibliographie Ent. 1:239, 1837.
- LEFÈVRE, Edouard (1839-1894). Ragonot, E. L., Ann. Soc. Ent. France 63 (Bull.):clxix-clxxi, ccl, 1894.
- LEFROY, Harold Maxwell (1877-1925). A., Nature 116:651-652, 1925.
- LEGIST, Leon (-1946). "L. B.," Lambilliona 46:117, 1946.
- LE GRICE, F. (-1902). A., Ent. Record 14:109, 1902.
- LEHMANN, August (1802-1868). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 299-301, 1874.
- LEIDY, Joseph (1823-1891). Ward, H. B., P., Archives Parasitol. 3:269-279, 1900.
- LEISHMANN, William Boog (1865-1926). "C. J. M.," P., Proc. Roy. Soc. Lond. (B) 102:ix-xviii, 1928.
- LELONG, B. M. (1858-1901). Essig, E. O., B., P., Hist. of Ent. pp. 685-687, 1931.
- LEMANN, Frederick C. (-1908). "A. H. J.," et al., Ent. Mo. Mag. 44:113-114, 1908; A., Ent. Record 20:96, 1908; Waterhouse, C. O., Trans. Ent. Soc. Lond. (Proc.):cvi, 1908.
- LEMÉE, Carlos (-1914). "J. L.," Rev. Soc. Ent. Arg. 11:169-172, 1941.
- LÉMERY, Nicolas (1645-1715). Rose, H. J., New Gen. Biog. Dict. 9:234, 1850.
- LEMMER, Frederick (1876-1941). Osborn, H., Fragments Ent. Hist. 2:95, 1946.
- LEMOINE, Victor (-1897). Grouvelle, A., Bull. Soc. Ent. France p. 129, 1897.
- LEMORO, Eugène (1841-1892). A., Leopoldina 28:156, 1892; Jourdeuille, C., Ann. Soc. Ent. France 61 (Bull.):xcii, 1892.
- LENG, Charles William (1859-1941). Osborn, H., Fragments Ent. Hist. 2:95-96, 1946.
- LENNON, William (1818-1899). Service, R., Ann. Scottish Nat. Hist. pp. 134-136, 1900.
- LENZ, Harald Othmar (1799-1870). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 305-307, 1874.
- LEO AFRICANUS, John (-1526). Rose, H. J., New Gen. Biog. Dict. 9:246, 1850.
- LEONHARD, Otto (1853-1929). Heikertinger, F., Koleopt. Rundschau 15:210-212, 1930.
- LEONI, Giuseppe (1866-1928). Grandi, G., B., Mem. Soc. Ent. Ital. 8:5-7, 1929.
- LESSER, Friedrich Christian (1692-1754). Eisel, J. N., Geschichte, Systematik und Literatur der Insecten. p. 32, 1836; Rose, H. J., New Gen. Biog. Dict. 9:256, 1850.
- LESSERT, Roger de (1875-1945). Revilliod, P., B., P., Verh. Schweiz. Naturf. Ges. 126:383-387, 1946; Bonnet, P., P., Bibliographia Araneorum p. 61, 1945.
- LESSONA, Michele (1823-1894). Camerano, L., B., P., Boll. Mus. Zool. ed Anat. Comp. Torino 9(188):1-72, 1894.
- LESTAGE, Johannes Antoine (1879-1945). Carpentier, F., B., P., Bull. Mus. Roy. Hist. Nat. Belg. 23(3):1-23, 1947.
- LETTSON, John Coakley (1744-1815). Rose, H. J., New Gen. Biog. Dict. 9:258, 1850.
- LEUCKART, Friedrich Sigismund (1794-1843). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 86 (footnote), 1874.
- LEUCKART, Karl Georg Friedrich Rudolf (1822-1898). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 86 (footnote), 1874; "E. R. L.," Proc. Roy. Soc. Lond. 75:19-22, 1904-05; A., P., Insekten-Börse 9(21):unpaged, 1892.
- LEUNIS, Johannes (1802-1873). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 307-309, 1874.
- LEUSSLER, Richard A. (1866-1943). Osborn, H., Fragments Ent. Hist. 2:96, 1946.
- LEUTHARDT, Franz (1861-1934). "E. R.," Tätigkeits-Bericht Naturf. Ges. Baselland 10:199-209, 1933-35.

- LEVRAT, Jean Nicolas Barthelemy Gustave (1823-1859). Mulsant, E., B., P., *Opuscules* Ent. 11:69-80, 1859; Mulsant, E., B., P., *Ann. Soc. Linn. Lyon*, n. s. 6:107-118, 1859.
- LEWIS, William Arnold (-1877). Briggs, T. H., *Ent. Mo. Mag.* 14:119, 1877; A., *Entomologist* 10:264, 1877; Westwood, J. O., *Trans. Ent. Soc. Lond. (Proc.)*:xl, 1877.
- LEYBOLD, Friedrich (1827-1879). A., B., *Leopoldina* 23:208-210, 1887.
- LIBAVIUS, Andreas (1560-1616). Rose, H. J., *New Gen. Biog. Dict.* 9:266, 1850.
- LICATUS (LICETI), Fortuneus (1577-1657). Rose, H. J., *New Gen. Biog. Dict.* 9:267, 1850.
- LICHTENSTEIN, Wilhelm Auguste Jules (1818-1886). Riley, C. V., *Scientific Amer.* 56:64, 1887; Bourgeois, J., *Ann. Soc. Ent. France* (6) 6 (Bull.):clxxxvi-clxxxvii, 1886.
- LICHTWARDT, Bernhard (1857-1943). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 10:174, 1943.
- LIDGETT, James (-1941). Miller, B. E., *Victorian Nat.* 58:47, 1941.
- LIEBECK, Charles (1863-1947). Richmond, K. F., et al., *Ent. News* 58:165-168, 1947.
- LIEBIG, Justus (1803-1873). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 312-317, 1874.
- LIEBMANN, Moritz (-1920). Spröngerts, I. R., *Iris* 35:52-53, 1921.
- LIÉNARD, Valère (1856-1886). Plateau, F., B., *Ann. Soc. Ent. Belg.* 30 (C. R.):cxlix-xli, 1886.
- LIENIG, Friederike (-1858). Reichenbach, L., *Allg. Deutsch. Naturh. Zeit.* 1:303-304, 1846.
- LIGHT, Sol Felty (1886-1947). A., *Pan-Pacific Ent.* 23:144, 1947; Bullock, T. H., *Science* 106:483-484, 1947; Essig, E. O., B., *Pan-Pacific Ent.* 24:49-53, 1948; Essig, E. O., *Ann. Ent. Soc. Amer.* 42:237-238, 1949.
- LIGNAC, Joseph Adrian de Large de (-1762). Rose, H. J., *New Gen. Biog. Dict.* 9:271, 1850.
- LINDEMAN, Karl Eduardovich (1844-1929). Mokrzecki, S., P., *Anz. f. Schädlingssk.* 5:65-67, 1929; Mokrzecki, Z., P., *Polskie Pismo Ent.* 7:300-302, 1929.
- LINDEMANS, Johannes (1874-1944). Zöllner, A. J., *Ent. Berichten* 12:97-100, 1947.
- LINDEN, Maria von (1869-1936). Horn, W., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 3:300, 1936.
- LINELL, Martin Larsson (1849-1897). Beutenmüller, W., *Journ. N. Y. Ent. Soc.* 5:207, 1897.
- LINNÉ, Carl von (1707-1778). A., *Ent. Zeitschrift* 21:69, 1907; Eiselt, J. N., *Geschichte, Systematik und Literatur der Insectenk.* pp. 35-45, 1836; Rose, H. J., *New Gen. Biog. Dict.* 9:282-286, 1850; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 317-326, 1874; Nuttall, G. H. F., P., *Parasitology* 13:401-402, 1921; Keep, J., *West Amer. Scientist* 3:118-119, 1887; Lizer y Trelles, C. A., *Curso de Entomologia* 1:8, 1947; Greene, E. L., P., *Ann. Rpt. Smithson. Inst.* pp. 685-709, 1907; Essig, E. O., *Hist. of Ent.* pp. 687-690, 1931; Carruthers, W., P., *Proc. Linn. Soc. Lond.* pp. 14-31, 1888-90; Percheron, A., B., *Bibliographie Ent.* 1:251-257, 1837; Jardine, W., B., P., *Naturalist's Library* 6:i-xxxii, 27-92, 1848; A., P., *Arxius Escola Sup. Agr. (Barcelona)* n. s. 1:76-80, 1934-35; Kunze, A., *Ent. Jahrbuch* 17:107-109, 1908; Dow, R. P., *Bull. Bklyn. Ent. Soc.* 8:37-38, 1912; Ross, E., *Internat. Ent. Ztschr.* 27:314-315, 1933; Bonnet, P., P., *Bibliographia Araneorum* pp. 28-29, 1945.
- LINNELL, John, Jr. (-1906). Saunders, E., *Ent. Mo. Mag.* 43:69-70, 1907.
- LINTNER, Joseph Albert (1822-1898). A., *Ent. Mo. Mag.* 34:165, 1898.
- LIRO, Johan (Jysi) Ivar (1872-1943). Saalas, U., *Ann. Ent. Fennici* 9:217-218, 1943; A., P., *l. c.* 8:199-202, 1942.
- LISLE, (Delisle), Guillaume de (1675-1726). Rose, H. J., *New Gen. Biog. Dict.* 7:50, 1850.
- LISTER, Martin (1638-1712). Eiselt, J. N., *Geschichte, Systematik und Literatur der Insectenk.* pp. 24-25, 1836; Rose, H. J., *New Gen. Biog. Dict.* 9:291, 1850.
- LITTLEWOOD, Frank (1882-1949). "A. E. W.," *Entomologist* 82:263-264, 1949.
- LIVETT, H. W. (-1901). Fowler, W. W., *Trans. Ent. Soc. Lond. (Proc.)*:xxxv, 1901.

- LIVINGSTONE, Clermont (-1907). Harvey, R. V., *Quart. Bull. Br. Col. Ent. Soc.* 8:1, 1907.
- LJUNGDAHL, David (1870-1940). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 9:65, 1942; Hellén, W., *Notulae Ent.* 23:59-60, 1943.
- LLANSÓ, Jaime (-1942). A., *Rev. Soc. Ent. Arg.* 11:382, 1942.
- LLOYD, Bertram (1881-1944). Hayward, H. H. S., *Northwestern Nat.* 19:192-193, 1944.
- LOCHHEAD, William (1864-1927). Leopold, B., *Ann. Rpt. Ent. Soc. Ont.* 58:86-91, 1927; A., *Ent. News* 38:196, 1927; A., *Canadian Ent.* 59:121-122, 1927; A., P., *Ann. Rpt. Quebec Soc. Protect. Plants* 19:11, 1927.
- LÖDING, Henry Peter (1869-1942). Jones, W. B., B., *Geol. Surv. Alabama, Mono.* 11:7-8, 1945; Osborn, H., *Fragments Ent. Hist.* 2:96-97, 1946.
- LÖVENDAL, Emil Adolf (1839-1901). Engelhart, C., P., *Ent. Meddelelser* 12:20-21, 1918.
- Löw, Franz (1829-1889). Douglas, J. W., *Ent. Mo. Mag.* 26:25-26, 1890.
- LOEW, Friedrich Hermann (1807-1879). A., *Le Naturaliste* 1:63, 1879.
- LOFTIN, Ulphian Carr (1890-1946). Heinrich, C., et al., B., P., *Proc. Ent. Soc. Wash.* 48:240-243, 1946; A., *Florida Ent.* 28:48-49, 1946; Van Dine, D. L., et al., P., *Journ. Econ. Ent.* 41:999-1000, 1948.
- LOMBARDI, Massimiliano (-1947). A., *Boll. Soc. Ent. Ital.* 77:1, 1947.
- LOMNICKI, Jeroslav (-1931). Kinel, J., B., P., *Polskie Pismo Ent.* 11:1-16, 1932.
- LOPEZ SEOANE, Victor (1834-1900). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:188, 1919.
- LÓSY, Josef (1874-1916). Csiki, E., B., *Rovartani Lapok* 24:124-125, 132, 1917.
- LOUDON, John Claudius (1783-1843). Rose, H. J., *New Gen. Biog. Dict.* 9:317-318, 1850.
- LOVELL, John Hatney (1860-1939). A., P., *Amer. Bee Journ.* 79:568-570, 1939.
- LOVETT, Arthur Lester (1883-1924). A., B. only, *Journ. Econ. Ent.* 17:501-504, 1924; Van Duzee, E. P., *Pan-Pacific Ent.* 1:48, 1924.
- LOWE, Frank E. (1854-1917). Wheeler, G., *Ent. Record* 30:59-60, 1918; Edwards, S., *Proc. So. Lond. Ent. & N. H. Soc.* p. 37, 1918-19.
- LOWE, William Henry (-1900). Verrall, G. H., *Trans. Ent. Soc. Lond. (Proc.)*: xliii, 1900.
- LOWREY, P. F. J. (-1891). Frohawk, F. W., *Entomologist* 24:200, 1891.
- LUBBOCK, John William (Lord Avebury) (1834-1913). Calvert, P. P., P., *Ent. News* 24:289-293, 1913; Wheeler, G., *Ent. Record* 25:171-172, 1913; A., *Ent. Zeitschrift* 27:56, 1913.
- LUCAS, Arthur Henry Shakespeare (1853-1936). Doley, C., *Victorian Nat.* 53:54-55, 1936.
- LUCAS, Pierre Hippolyte (1814-1899). Alluaud, C., *Bull. Soc. Ent. France* p. 241, 1899; Bonnet, P., P., *Bibliographia Araneorum* p. 37, 1945; Lacroux, A., *Bull. Mus. Nat. Hist. Nat. (Paris)* (2) 10:470-471, 1938.
- LUDOLF (LEUTHOLF), Hiob (Job) (1624-1704). Rose, H. J., *New Gen. Biog. Dict.* 9:348, 1850.
- LUDY, Friedrich (-1896). A., *Wiener Ent. Zeit.* 15:124, 1896.
- LÜDDEMANN, Andreas (1858-1938). Horn, W., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 5:296, 1938.
- LÜDEKE, Oscar (1854-1942). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 9:206, 1942.
- LUEDERWALDT, Hermann (1865-1934). Taunay, A. de E., B., P., *Rev. Mus. Paulista* 21:31-47, 1937; Lizer y Trelles, C. A., *Curso de Entomologia* 1:21, 1947.
- LUETGENS, August (1838-1908). A., *Journ. N. Y. Ent. Soc.* 16:52, 1908.
- LUFF, William Ambridge (1851-1910). "F. E. L.," B., *Ent. Record* 22:187-189, 1910; Marquand, E. D., et al., B., *Trans. Guernsey Soc. Nat. Sci.* 6:147-154, 1910.
- LUIGIONI, Paolo (1873-1937). Lepri, G., P., *Riv. Biol. (Firenze)* 25:377-378, 1938.
- LUMIALA, Onni Veikko (1910-1944). Suomalainen, E., B., P., *Ann. Ent. Fennici* 10:145-148, 155, 1944; Kotilainen, M. J., P., *Mem. Soc. Fauna Flora Fenn.* 21:233-238, 1945.
- LUND, Gustav Budde (1846-1911) (See under BUDE-LUND).

- LUND, Niels Tönder (1749-). Henriksen, K. L., Ent. Meddelelser 15:106-109, 1923.
- LUNDBECK, William (1863-1941). Kryger, J. P., B., P., Ent. Meddelelser 22:268-273, 1942; Spärck, R., P., Vidensk. Medd. Dansk. Naturh. Foren. København 105:v-vii, 1942; Hellen, W., Notulae Ent. 23:60, 1943; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 8:286, 1941.
- LUTSCHNIK (LUTSNIK), Viktora Nikolaevicha (1892-1936). Plavilstshikov, N., Ent. Blätter 32:136, 1936; Spacek, K., Acta Soc. Ent. Cechoslov 34:14-15, 1937; Plavilstshikov, N., Miscellanea Ent. 37:67, 1937; Plavilstshikov, N., Ent. Nachrichtenbl. 10:111, 1936.
- LUTZ, Adolpho (1855-1940). Morgan, E., P., Journ. Trop. Med. & Hyg. 44:99-101, 1941; Stunkard, H. W., Journ. Parasitol. 27:469-471, 1941; Travassos, L., Rev. Brasil Biol. 1:111-114, 1941; A., B., P., Brasil Medico 54:855-858, 874-878, 1940; 55:16-18, 1941; A., Copeia 4:275-276, 1940; A., Rev. Ent. (Brasil) 11:963-966, 1940; Borgmeier, T., P., l. c. 5:359-361, 1935; Birabén, M., B., P., Rev. Mus. La Plata, Secc. Oficial:149-157, 1940 (1941); Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 9:284, 1942; Lizer y Trelles, C. A., Curso de Entomologia 1:20-21, 1947; Howard, L. O., P., Pop. Sci. Monthly 87:170, 1915.
- LUTZ, Frank Eugene (1879-1943). Barton, D. R., P., Natural History 48:181-185, 1941; Osborn, H., Fragments Ent. Hist. 2:97-98, 1946.
- LUTZAN, Karl von (1850-1923). Kupffer, K. R., B., Korrespondenzbl. Naturf. Ver. Riga 58:7-8, 1924.
- LYLE, George Trevor (1873-1930). "W. J. F.," P., Naturalist (Lond.) pp. 434-435, 1930; A., Trans. Suffolk Nat. Soc. 1 (Proc.):xlviii-xlix, 1930.
- LYMAN, Henry Herbert (1854-1914). A., Ent. Record 27:96, 1915; A., Ent. Mo. Mag. 50:252, 1914; A., P., Canadian Ent. 80:21-22, 1948.
- LYNCH-ARRIBÁLZAGA, Enrique (1856-1935). Porter, C. E., P., Rev. Chilena Hist. Nat. 39:392, 1935; A., B., Physis (Arg.) 12:180-182, 1936; Lizer y Trelles, C. A., Curso de Entomologia 1:36-37, 1947.
- LYNCH-ARRIBÁLZAGA, Felix (1854-1894). Dallas, E. E., B., P., Rev. Soc. Ent. Arg. 2:5-12, 1928.
- LYONNET, Pieter (1707-1789). Rose, H. J., New Gen. Biog. Dict. 9:367, 1850; Lizer y Trelles, C. A., Curso de Entomologia 1:9, 1947.
- LYSHOLM, Bjarne (1861-1939). Strand, A., B., P., Norsk Ent. Tidsskrift 5:189-190, 1940; Natvig, L. R., P., l. c. 3:2, 1932; Hellén, W., Notulae Ent. 23:59, 1943.
- MAASS, Franz (1850-1929). Rapp, O., P., Ent. Blätter 26:1-4, 1930.
- MCCARTHUR, Harry (-1910). A., Ent. Record 22:76, 1910; South, R., Entomologist 43:103-104, 1910.
- MCCOLLOCH, James Walker (1889-1929). Smith, R. C., B., Journ. Kansas Ent. Soc. 6:137-142, 1933; Dean, G. A., P., l. c. 14:1-2, 1941.
- MCCOOK, Henry Christopher (1837-1911). Ludwig, D. K., B., P., Journ. Presbyterian Hist. Soc. 6:97-146, 1911; Howard, L. O., Dict. Amer. Biog. 11:603, 1933; Bonnet, P., P., Bibliographia Araneorum pp. 44-45, 1945.
- MCCOY, Frederick (1823-1899). "H. W.," Proc. Roy. Soc. Lond. 75:43-45, 1904-05.
- MACCULLOCH, John (1773-1835). Rose, H. J., New Gen. Biog. Dict. 9:379-380, 1850.
- MACKIE, David Barclay (1882-1944). A., P., Bull. Calif. Dept. Agr. 33:67-68, 1944; Keifer, H. H., l. c. 34:3, 1945.
- McLAINE, Leonard Septimus (1887-1943). Mackie, D., P., Bull. Calif. Dept. Agr. 33:3, 1944; Osborn, H., Fragments Ent. Hist. 2:98, 1946.
- MACLAURIN, Colin (1698-1746). Rose, H. J., New Gen. Biog. Dict. 9:390-392, 1850.
- MACLEAY, William (1820-1891). A., Ent. Mo. Mag. 28:26, 1892; Godman, F. D., Trans. Ent. Soc. Lond. (Proc.):li, 1891.
- MACLEAY, William Sharp (1792-1865). Eiselt, J. N., Geschichte, Syst. und Literatur der Insectenk. pp. 88-92, 1836; Sanchez y Roig, M., Mem. Soc. Cubana Hist. Nat. 2:73-78, 1916.
- McCLUNG, Clarence Erwin (1870-1946). Wenrich, D. H., Science 103:551-552, 1946.
- MCDONOUGH, Fred C. (1889-1938). A., U. S. Dept. Agr. Bur. Ent. Plant Quar. News Letter 5(9):1, 1938.

- MACFIE, John William Scott (1879-1948). "P. F. M." *Entomologist* 82:21-22, 1949; Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (C)* 13:68, 1948-49.
- MAGGILLIVRAY, Alexander (1868-1924). Comstock, J. H., *Science* 59:503, 1924.
- MCGREGOR, Malcolm Evan (1889-1933). *A.*, *Nature* 131:123, 1933; Horn, W., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 1:305, 1934.
- MACKIE, David Barclay (1882-1944). *A.*, *P.*, *Bull. Calif. Dept. Agr.* 33:67-68, 1944; *A.*, *Journ. Econ. Ent.* 37:268, 1944.
- McKINNEY, Kenneth Barbee (1890-1946). Caffrey, D. J., et al., *Journ. Econ. Ent.* 40:283-284, 1947.
- McLACHLAN, Robert (1837-1904). Saunders, E., *Proc. Linn. Soc. Lond.* 117:42-43, 1904; *A.*, *Insekten-Börse* 21:267, 1904; "E. S.," *Proc. Roy. Soc. Lond.* 75:367-370, 1905.
- McNAB, William Ramsay (1844-1889). *A.*, *Ent. Mo. Mag.* 26:26, 1890.
- McNAY, Everett J. (1910-1939). *A.*, *P.*, *Amer. Bee Journ.* 79:176, 1939.
- MACQUER, Pierre Joseph (1718-1784). Rose, H. J., *New Gen. Biog. Dict.* 9:395, 1850.
- MAKLIN, Friedrich Wilhelm (1821-1883). Riley, C. V., *Amer. Nat.* 17:424, 1883; *A.*, *Ent. Nachrichten* 9:56, 1883.
- MAGNUS GOTHUS, Olaus (1490-1568). Rose, H. J., *New Gen. Biog. Dict.* 9:412, 1850.
- MAGRETTI, Paolo (1854-1913). Sordelli, F., *B.*, *P.*, *Atti Soc. Ital. Sci. Nat. Mus. Civ. Stor. Nat. Milano* 53:1-10, 1914.
- MAIN, Hugh (-1948). Blair, K. G., *Ent. Mo. Mag.* 84:96, 1948; Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (C)* 13:68, 1948-49.
- MAINDRON, Maurice (1857-1911). Desbordes, H., *P.*, *Deutsche Ent. Nat.-Bibliothek* 2:136, 1911.
- MAJOR, John Daniel (1634-1693). Rose, H. J., *New Gen. Biog. Dict.* 9:435, 1850.
- MALEZIEU, Nicolas de (1650-1727). Rose, H. J., *New Gen. Biog. Dict.* 9:445, 1850.
- MALLY, Frederick William (1868-1939). Osborn, H., *P.*, *Fragments Ent. Hist.* 2:99-102, 1946.
- MALM, August Wilhelm (1821-1882). *A.*, *Wiener Ent. Zeit.* 1:128, 1882.
- MALMAZET, Jean Andre (1808-1858). Mulsant, E., *P.*, *Ann. Soc. Linn. Lyon* 25:75-82, 1878.
- MALOCH, Johann (Jan) (1825-1911). Uzel, J., *P.*, *Acta Soc. Ent. Bohemiae* 8:57-59, 1911.
- MALPIGHI, Marcello (1628-1694). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 328-329, 1872-74; Rose, H. J., *New Gen. Biog. Dict.* 9:450, 1850; *A.*, *P.*, *Insecta* 10:48-49, 1920.
- MANDERS, Neville (1857-1915). Rowland-Brown, H., *Ent. Mo. Mag.* 51:317-319, 1915; Wheeler, G., *Ent. Record* 27:239-240, 1915.
- MANDEVILLE, Bernard de (1670(?) -1733). Rose, H. J., *New Gen. Biog. Dict.* 9:454-456, 1850.
- MANEVAL, Jean Charles Henri (1892-1942). Maublanc, A., *Bull. Soc. Ent. France* 47:98, 1942; Segers, C., *Bull. & Ann. Soc. Ent. Belg.* 81:225, 1945; Pitou, L., *B.*, *P.*, *Rev. Sci. Nat. Auvergne* 9(1-4):1-4, 1943.
- MANGANARO, Ana Giordano (-1921). Trotter, A., *Marcellia* 19:xxxv, 1920.
- MANK, Edith Webster (1892-1945). Weiss, H. B., *B.*, *Ann. Ent. Soc. Amer.* 39:4, 1946.
- MANSON, Patrick (1844-1922). Wood, E. J., *P.*, *Amer. Journ. Trop. Med.* 2:361-368, 1922; Howard, L. O., *P.*, *Pop. Sci. Monthly* 87:66, 1915.
- MAPLE, John Dinwiddie II (1910-1945). Deonier, C. C., *Journ. Econ. Ent.* 38:414, 1945; Flanders, S. E., *Ann. Ent. Soc. Amer.* 39:4-5, 1946; Stage, H. H., *Proc. Ent. Soc. Wash.* 48:60, 1946.
- MARALDI, Giacomo Filippo (1665-1729). Rose, H. J., *New Gen. Biog. Dict.* 9:470, 1850.
- MARCGRAVE, George (Jorge) (1610-1644). Gudger, E. W., *Pop. Sci. Mo.* 81:250-274, 1912.
- MARCHAL, Paul (1862-1942). Vayssière, P., *B.*, *P.*, *Ann. Soc. Ent. France* 111:149-165, 1942; Vayssière, P., *Ann. Inst. Nat. Agron. (Paris)* 33:5-33, 1942; Hitier, H. C. R. *Acad. Agr. France* 31:392-394, 1945; del Cañizo, J., *P.*, *Bol. Patol. Veg. Ent. Agr. (Madrid)* 12:481-485, 1944; Sachtleben, H., *Arb. Morph. Taxon. Ent.*

- Berlin-Dahlem 9:133, 1942; Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 9:127, 1942.
- MARCHIAFAVOR, Ettore (1847-1935). Hackett, L. W., Journ. Parasitol. 22:219-220, 1936.
- MARCHOUX, Emile (1862-1943). Roubaud, E., Bull. Soc. Pathol. Exot. 36:319-324, 1943.
- MARMONT, Lindsay Edgar (1860-1949). Glendenning, R., Proc. Ent. Soc. Br. Col. 45:32, 1949.
- MARNIX, Philippe de (1538-1598). Rose, H. J., New Gen. Biog. Dict. 9:498, 1850.
- MARQUAND, Ernest David (1848-1918). Rowswell, B. T., B., Trans. Guernsey Soc. Nat. Sci. 8:83-90, 1918.
- MARQUES AZEVEDO, Luis Augusto (-1939). A., Rev. Ent. (Brasil) 10:483, 1939.
- MARQUET, Charles (1820-1900). A., Miscellanea Ent. 8:70, 1900.
- MARSCHALL, August Friedrich (1804-1887). Rogenhofer, A., Verh. Zool.-Bot. Ges. Wien 37 (Sitzb.):62-63, 1887.
- MARSEUL, Sylvain Augustin de (1812-1890). Godman, F. D., Trans. Ent. Soc. Lond. (Proc.):lviii, 1890.
- MARSHALL, Thomas Ansell (1827-1903). Bignell, G. C., Ent. Record 15:190-191, 1903; McLachlan, R., Ent. Mo. Mag. 39:152-153, 1903; Poulton, E. B., Trans. Ent. Soc. Lond. (Proc.):lxxv-lxxvi, 1903.
- MARSIGLI (MARSILIUS), Luigi Fernando (1658-1730). Rose, H. J., New Gen. Biog. Dict. 9:504-505, 1850.
- MARTENS, Georg Matthias (1788-1872). A., Leopoldina 7:91, 1872.
- MARTIN, Henry Newell (1848-1896). A., Irish Nat. 6:103, 1897.
- MARTIN, Joanny (-1905). Bouvier, E. L., Bull. Soc. Ent. France pp. 221-222, 1905.
- MARTIN, Ludwig (1858-1924). Rosen, K. von, B., Iris 39:5-10, 1925.
- MARTINEAU, Alfred Hyde (-1934). A., Ent. Mo. Mag. 70:279-280, 1934.
- MARTINEZ Y SÁEZ, Francisco de Paula (1835-1908). Gogorza, J., B., P., Bol. Soc. Españ. Hist. Nat. 8:208-215, 1908.
- MARTINI, Carl Johann Rudolf (1812-). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 343-349, 1874.
- MARTINI, Wilhelm (1846-1913). A., P., Ent. Zeitschrift 27:132, 1913.
- MARTY, Thomas (1735-1825). Rose, H. J., New Gen. Biog. Dict. 10:5-6, 1850; Weiss, H. B., Journ. N. Y. Ent. Soc. 46:321-325, 1938.
- MARTYNOV, Andrei Vassilievitch (1879-1938). Uvarov, B. P., Nature 141:401-402, 1938; Cockerell, T. D. A., Science 87:292, 1938.
- MARX, George (1838-1895). Bonnet, P., P., Bibliographia Araneorum p. 45, 1945.
- MASKELL, William Miles (1840-1898). Verrall, G. H., Trans. Ent. Soc. Lond. (Proc.):liv-lv, 1898.
- MASKEW, Frederick (-1923). A., Calif. Cultivator 61:658, 1923.
- MASON, Philip Brookes (1842-1903). Poulton, E. B., Trans. Ent. Soc. Lond. (Proc.):lxxvi, 1903; A., Ent. Record 15: 345, 1903; Fowler, W. W., Ent. Mo. Mag. 40:17-18, 1904; A., The Lancet 165:1405-1406, 1903; Ellis, H. W., Proc. Roy. Soc. Lond. (A) 17:63, 1942.
- MASSALONGO, Caro (1852-1928). Trotter, A., B., P., Marcellia 24:144-155, 1927.
- MASSALONGO, Orseolo (-1901). A., Insekten-Börse 18:234, 1901.
- MATA, Antonio B. (1902-1926). A., P., Rev. Soc. Ent. Arg. 1(2):2, 1926; Lizer y Trelles, C. A., Curso de Entomologia 1:51, 1947.
- MATHEU, Auguste (1814-1890). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 349-350, 1874.
- MATSUSHITA, M. (-1944). Remington, C. L., Ann. Ent. Soc. Amer. 39:449, 1946.
- MATTIOLUS (MATTIOLI), Pietro Andrea (Pierandrea) (1501-1577). Ambrosi, F., Bull. Soc. Veneto-Trent. Sci. Nat. Padova 4:139-141, 1889.
- MAUDUIT, Israel (1708-1787). Rose, H. J., New Gen. Biog. Dict. 10:44, 1850.
- MAURISSEN, Adrien Hubert (-1892). Sélys-Longchamps, M. E. de, Ann. Soc. Ent. Belg. 36:389-391, 1892.
- MAURIZIO, Adam (1862-1941). Volkhardt, A., B., P., Verh. Schweiz. Naturf. Ges. 121:389-394, 1941.
- MAWE, John (1764-1829). Rose, H. J., New Gen. Biog. Dict. 10:53, 1850.
- MAY, Harry H. (1878-1943). Wynn, G. W., et al., Ent. Mo. Mag. 80:43, 1944.

- MAY, John William (1814-1902). *A.*, Ent. Mo. Mag. 38:186, 1902; Fowler, W. W., Trans. Ent. Soc. Lond. (Proc.):lviii-lix, 1902.
- MAYER, Karel (1912-1939). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 7:336, 1940.
- MAYER, Paul (1848-1923). Péterfi, T., B., P., Ztschr. Wiss. Mikroskopie 41:145-154, 1924.
- MAYET, Valéry (1839-1909). *A.*, Ent. Rundschau 26:74, 1909; Horn, W., Deutsche Ent. Ztschr. p. 583, 1909.
- MAZARREDO, Carlos (-1910). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:172, 1919.
- MAZZA, Salvador (-1946). Birabén, M., Rev. Soc. Ent. Arg. 13:341-343, 1947.
- MECHNIKOV, Ilya Ilich (1845-1916). Semenov-Tian-Shansky, A., Rev. Russe Ent. 16:399-404, 1916. (See also under METCHNIKOFF)
- MECKLENBURG-STREBLITZ, Adolph Friedrich (1882-1918). Rehn, J. A. G., Ent. News 29:159-160, 1918.
- MEIDELL, Ove (1903-1942). Holgersen, H., B., P., Norsk Ent. Tidsskrift 6:226-228, 1942.
- MEINERT, Frederik Vilhelm August (1833-1912). *A.*, Ent. Mo. Mag. 39:153, 175 1903 (false report); Engelhart, C., Ent. Meddelelser 12:18, 1918.
- MEISSNER, Georg (1829-1905). Weiss, O., Naturw. Rundschau 20:349-351, 1904.
- MELDOLA, Raphael (1849-1915). "W. A. T.," et al., P., Proc. Roy. Soc. Lond. (A) 93:xxxix-xxxvii, 1917.
- MELIN, Douglas (1895-1946). Lundblad, O., P., Ent. Tidskrift 67:215-217, 1946.
- MELLIN, Alfred (1859-1920). Marschner, H., Jahresh. Ver. Schles. Insektenk. Breslau 13:23-24, 1921.
- MELLO-LEITAO, Candido Firmino de (1886-1948). *A.*, B., P., Bol. Escola Nac. Agron. (Rio de J.) 1:71-96, 1938; Porter, C. E., P., Rev. Chilena Hist. Nat. 42:347, 1938; Birabén, M., Rev. Soc. Ent. Arg. 14:238-240, 1949; Bonnet, P., P., Bibliographia Araneorum p. 68, 1945.
- MELLY, André (1802-1851). Westwood, J. O., Trans. Ent. Soc. Lond. n. s. 1 (Proc.):137, 1850-51.
- MELSHEIMER, Friedrich Ernst (1782-1873). Arnett, R. J., Jr., Coleopterists' Bull. 2:27-28, 1948.
- MELZER, Julius (1878-1934). Lizer y Trelles, C. A., Curso de Entomologia 1:22, 1947.
- MENDENHALL, Eugene Warren (1874-1944). *A.*, Journ. Econ. Ent. 37:331, 1944; Barringer, J. W., Ann. Ent. Soc. Amer. 38:142, 1945; Osborn, H., P., Fragments Ent. Hist. 2:102, 1946.
- MENDES AZEVEDO, Candido (1874-1944). Luisier, A., B., Broteria 40:43-48, 1944.
- MENGE, Franz Anton (1808-1880). Bonnet, P., P., Bibliographia Araneorum pp. 35-36, 1945.
- MENGEL, Levi Walter Scott (1868-1941). Ent. News 52:178-180, 1941.
- MENOZZI, Carlos (1892-1943). del Cañizo, J., Inst. Nac. de Invest. Agron. B. de Patol. Veg. y Ent. Agr. 12:489-490, 1943; De Beaux, P., Ann. Mus. Civ. Stor. Nat. Genova 62:(2)-(3), 1945; *A.*, Ent. News 57:99, 1946; Grandi, G., B., P., Bol. Ist. Ent. R. Univ. Bologna 14:193-201, 1943; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 10:256-257, 1943; Grandi, G., B., Mem. Soc. Ent. Ital. 22:118-124, 1943; Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 10:169-170, 1943.
- MENTZEL, Christian (1622-1701). Rose, H. J., New Gen. Biog. Dict. 10:99-100, 1850.
- MERA, Arthur William (1849-1930). "J. A. S.," P., Lond. Nat. pp. 37-38, 1930.
- MERIAN, Maria Sibylla (1647-1717). Dittmar, A., Ent. Zeitschrift 30:89-90, 94-95, 98-99, 1917; Eiselt, J. N., Geschichte, Syst. und Literatur der Insektenk. pp. 26-27, 1836; Ruediger, E., Ent. Rundschau 54:391-394, 1937; Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 352, 1874; Rose, H. J., New Gen. Biog. Dict. 10:105, 1850; Percheron, A., B., Bibliographie Ent. 1:279-280, 1837; Eisinger, F., P., Internat. Ent. Ztschr. 4:67-68, 74-76, 1910.
- MERKEL, August (1837-1897). Dietz, O., Ent. News 8:184, 1891.
- MERRET, Christopher (1614-1695). Rose, H. J., New Gen. Biog. Dict. 10:106, 1850.
- MERRILL, Joseph Henry (1881-1946). Shaw, F. R., et al., Mass. State Coll. Fernald Yearbook 16:2, 24, 1947; Metcalf, Z. P., P., Journ. Econ. Ent. 40:141, 1947.

- MESNIL, Felix (1868-1938). Caullery, M., *P.*, Bull. Biol. France & Belg. 72(2):4 pp., (unpagged), 1938; Joyeux, C., *P.*, Riv. Parassitol. 2:250-251, 1938; Roubaud, E., *P.*, Bull. Soc. Path. Exot. 31:173-177, 1938; A., *P.*, Arch. Inst. Pasteur Algerie 16:1-2, 1938.
- METCALF, Clell Lee (1888-1948). Baldus, W. V., *P.*, Journ. Econ. Ent. 41:997-998, 1948.
- METCHNIKOFF, (MECHNIKOV or MECZNIKOW), Ilya (Elie) Ilich (1845-1916). "E. R. L." Proc. Roy. Soc. Lond. (B) 89:li-lix, 1915-17; Lankester, R., Nature 97:443-446, 1916; Plá, E. F., *B.*, Mem. Soc. Cubana Hist. Nat. 2:228-234, 1916; Petrie, G. F., Nature 149:547-548, 1942.
- MEUCHE, Alfred (1913-1942). Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 10:260, 1943.
- MEVES, Friedrich Wilhelm (1814-1891). Sandahl, O. T., *P.*, Ent. Tidschrift 12:81-86, 1891.
- MEYER, Felix (1853-1926). "K. A.," et al., *P.*, Ent. Zeitschrift 40:33-34, 1926.
- MEYER, Nicolas (1734-1775). Füessly, J. O., Mag. für die Liebhaber der Ent. 2:51-65, 1779.
- MEYERINCK, Heinrich Eugén von (1786-1848). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 357-360, 1874.
- MEYRICK, Edward (1854-1938). Freyer, J. C. F., Proc. Roy. Ent. Soc. (Lond.) (C) 3:58-59, 1938; Tams, W. H. T., Nature 141:776-777, 1938; Günther, K., Iris 52:96-97, 1938; "J. S. G.," et al., *P.*, Rpt. Marlboro Coll. N. H. Soc. 87:51-53, 1939; Hill, A. W., *B.*, *P.*, Obit. Notices Fellows Roy. Soc. (Lond.) 2:531-548, 1939; "G. V. H.," *P.*, Trans. & Proc. Roy. Soc. N. Z. 68(2):141-142, 1938.
- MICHAUX, François André (1770-1855). Rose, H. J., New Gen. Biog. Dict. 10:127, 1850.
- MICHELET, Jules (1798-1874). A., Ent. Nachrichten 2:112, 1876.
- MIDDENDORFF, Alexander Theodor (1815-1894). Ratzeburg, J. T. C., *B.*, Forstwissenschaftliches Schriftsteller-Lexikon pp. 360-370, 1874.
- MIGNEAUX, Jules (-1898). A., Ent. Mo. Mag. 34:140, 1898; A., *P.*, Le Naturaliste 20:101-102, 1898; Bouvier, E. L., Bull. Soc. Ent. France pp. 121-122, 1898.
- MIK, Josef (1839-1900). A., *P.*, Insekten-Börse 17:353, 1900; Verrall, E. B., Trans. Ent. Soc. Lond. (Proc.):xliv-xlv, 1900; A., Miscellanea Ent. 8:24, 1900.
- MIKAN, Johann Christian (1769-1844). Eiselt, J. N., Geschichte, Syst. und Literatur der Insecten. p. 65, 1836.
- MILLER, Ellen Robertson (-1937). Osborn, H., *P.*, Fragments Ent. Hist. 2:103, 1946.
- MILLIÈRE, Pierre (1811-1887). des Gozis, M., *B.*, Rev. d'Ent. 6:248-253, 1887.
- MILLIN DE GRANDMAISON, Aubin Louis (1759-1818). Rose, H. J., New Gen. Biog. Dict. 10:143, 1850.
- MIMEUR, Jean Marie (1898-1945). Werner, R. G., Bull. Soc. Sci. Nat. Maroc 25:27:26-27, 1945:47.
- MINCHIN, Edward Ailfred (1866-1915). Woodcock, H. M., *P.*, Parasitology 25:157-162, 1925.
- MINKIEWICZ, Stanislaw (1877-1944). Gibson, A., Canadian Ent. 77:116, 1945; Prüffer, J., et al., *B.*, *P.*, Polskie Pismo Ent. 19:3-22, 1949; Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 11:158-159, 1944.
- MISRA, Rai Bahadur Chandra Shekar (1880-1939). Bose, B. B., Indian Journ. Ent. 2:114-115, 1940.
- MITIS, Heinrich R. von (1845-1905). Rebel, H., *B.*, Verh. Zool.-Bot. Ges. Wien 55:267-269, 1905.
- MITSUKURI, Kakichi (1857-1909). Horn, W., Deutsche Ent. Ztschr. p. 212, 1910.
- MITTEN, George (1826-1916). Davis, J. J., *P.*, Proc. Indiana Acad. Sci. 41:52, 1931.
- MNISZECH, Georges Vandalin (-1881). Deyrolle, H., Ann. Soc. Ent. France (6) 1 (Bull.):cxlii-cxlv, 1881.
- MOCÁRY, Sándor (Alexander) (1841-1915). A., *B.*, *P.*, Rovartani Lapok 23:2-7, 1916.
- MOCZARSKI, Emil (1879-1945). Jarvis, C. M., Ent. Mo. Mag. 82:160, 1946; Schedl, K. E., Zentralbl. Gesamtgeb. Ent. 1:95, 1946.

- MOE, Niels Green (1812-1892). *Natvig*, L. R., *Norsk Ent. Tidsskrift* 7:15-16, 1944; Schöyen, W. M., *Ent. Tidskrift* 13:275-279, 1892.
- MÖBIUS, Karl (1825-1905). *A.*, *Insekten-Börse* 12:37, 1895.
- MÖLLER, Carl August (1845-1912). Engelhart, C., *P.*, *Ent. Meddelelser* 12:16-17, 1918.
- MOFFAT, Charles Bethune (1859-1945). Kennedy, P. G., et al., *P.*, *Irish Nat. Journ.* 8:349-370, 1946.
- MOGRIDGE, John Traherne (-1874). Saunders, S. S., *Trans. Ent. Soc. Lond. (Proc.)*:xxxvii, 1874.
- MOHL, Hugo von (1805-1872). Ahles, Jahresh. Ver. Vaterl. Naturk. Württemb. 29:41-65, 1873.
- MOILLIET, Theodore Albert (1883-1935). Moilliet, T. K., *P.*, *Proc. Ent. Soc. Br. Col.* 43:43-45, 1947.
- MOKRZECKI, Zygmunt Atanazy (1865-1936). Howard, L. O., *P.*, *Journ. Econ. Ent.* 7:247-248, 1914; Nowicki, S., *P.*, *Ztschr. Angew. Ent.* 24:656-657, 1938; Lomnicki, W., *B.* only, *Polski Pismo Ent.* 6:11-30, 1927; Minkiewicz, S., *B.*, *P.*, *Na Jubileusz 70-Lecia Urodzin Prof. Z. Mokrzeckiego*, (Pulawy) pp. 1-31, 1935.
- MOLEYRE, Louis (-1886). Bourgeois, J., *Ann. Soc. Ent. France* (6) 6 (Bull.):xvii, 1886.
- MOLINA, Juan Ignacio (1740-1829). Liebermann, J., *Physis* (Arg.) 10:316-321, 1931; Lizer y Trelles, C. A., *Curso de Entomologia* 1:23, 1947; Mackenna, V., *Anal. Univ. Chile* 17:600-634, 1860; Barros Arana, D., *B.*, *Rev. Chilena Hist. Nat.* 1:289-300, 1881; Barros Arana, D., *Bibliografia de las obras de Don J. I. Molina*, Santiago, 1911; O'Ryan, E., *B.* & *P.* only, *Rev. Chilena Hist. Nat.* 6:3-4, 1902.
- MOLLER, Daniel (1642-1722). Rose, H. J., *New Gen. Biog. Dict.* 10:171, 1850.
- MOLYNEUX, William (1656-1698). Rose, H. J., *New Gen. Biog. Dict.* 10:172-174, 1850.
- MONCREIFFE, Thomas (1822-1878). White, F. B., *P.*, *Scottish Nat.* 5:145-148, 1879.
- MONTAGU, George (1755-1815). Rose, H. J., *New Gen. Biog. Dict.* 10:189, 1850.
- MONTANO, Benito Arias (1527-1598). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:76, 1919.
- MONTE, Oscar (1895-1948). Borgmeier, T., *Rev. Ent. (Brasil)* 19:589-590, 1948.
- MONTGOMERY, Edmund Duncan (1835-1911). Geiser, S. W., *Southwest Review* 16:200-235, 1931; Geiser, S. W., *Field & Lab.* 4:51, 1936.
- MONTGOMERY, J. H. (1875-1940). "E. W. B.," *Florida Ent.* 23:25-26, 1940.
- MONTGOMERY, Robert Eustace (1880-). Roubaud, E., *Bull. Soc. Path. Exot.* 31:178-179, 1938.
- MONTGOMERY, Thomas Harrison, Jr. (1873-1912). Bonnet, P., *P.*, *Bibliographia Araneorum* pp. 55-56, 1945.
- MONTI, Rina (1861-1937). Jucci, C., *B.*, *P.*, *Festschr. Embrik Strand* 4:664-670, 1938; Pirocchi, L., *B.*, *P.*, *Atti Soc. Ital. Nat. Mus. Civ. Stor. Nat. Milano* 76:55-69, 1937.
- MOORE, Frederic (1830-1907). Krancher, O., *P.*, *Ent. Jahrbuch* 17:199, 1908; *A.*, *Ent. Zeitschrift* 21:102, 1907.
- MOORE, John Lee (1877-1939). *A.*, *Trans. Suffolk Nat. Soc.* 5:xcvi-xcvii, 1945.
- MORAND, Jean François Clement (1724-1784). Rose, H. J., *New Gen. Biog. Dict.* 10:208-209, 1850.
- MORDWILKO, Alexander Konstantin (1867-1938). Uvarov, B. P., *Nature* 142:1027-1028, 1938; Kuznezov, N. J., *B.* only, *Rev. Ent. U. R. S. S.* 27:135-137, 1945.
- MORE, Alexander Goodman (1830-1895). *A.*, *Natural Science* 6:351, 1895.
- MORGAN, Alfred Cookman (1876-1931). *A.*, *Journ. Econ. Ent.* 24:1114, 1931.
- MORGAN, Thomas Hunt (1866-1945). Muller, H. J., *Science* 103:550-551, 1946; Sturtevant, A. H., *P.*, *Amer. Nat.* 80:22-23, 1946.
- MORODER SALA, Emilio (-). *A.*, *Ciencia (Mex.)* 1:121, 1940.
- MORRIS, Francis Orpen (1810-1893). Elwes, H. J., *Trans. Ent. Soc. Lond. (Proc.)*:lviii, 1893.
- MORS, Hans (-1941). Wellenstein, G., *B.*, *P.*, *Ztschr. Angew. Ent.* 30:157-159, 1943.
- MORSE, Albert Pitts (1863-1936). Osborn, H., *P.*, *Fragments Ent. Hist.* 2:103, 1946.
- MOSELY, Martin Ephraim (-1948). Kimmins, D. E., *Ent. Mo. Mag.* 84:240, 1948; Williams, C. B., *Proc. Roy. Ent. Soc. Lond. (C)* 13:69, 1948-49.

- MOSE, Julius (-1929). "W. M.," Stettiner Ent. Zeit. 90:325-326, 1929; Ross, E., Internat. Ent. Ztschr. 27:538, 1934.
- MOUFFET (MOUFFET, MOFFETT), Thomas (1553-1604). Eisel, J. N., Geschichte, Syst. und Literatur der Insecten. pp. 17-18, 1836; Lizer y Trelles, C. A., Curso de Entomologia 1:6-7, 1947; Rose, H. J., New Gen. Biog. Dict. 10:245-246, 1850.
- MOULTON, John Coney (1886-1926). A., Ent. News 38:64, 1927.
- MÜGGENBURG, Friedrich Hans (1865-1901). Lichtwardt, B., Ztschr. Syst. Hymenopt. & Dipt. 2:1, 1902.
- MÜHL, Adolf (1834-1911). "Sg.," P., Deutsche Ent. Nat.-Bibl. 2:135, 1911.
- MÜHLEN, Max von zur (1850-1918). Schneider, G., Korrespondenzbl. Naturf.-Ver. Riga 59:5-6, 1927.
- MÜLLER, A. Julius (1853-1926). Heikertinger, F., B., Koleopt. Rundschau 13:89, 1927.
- MÜLLER, F. A. Clemens (1829-1902). Daniel, K., Münch. Koleopt. Ztschr. 1:261, 1903; Kraatz, G., Deutsche Ent. Ztschr. 47:173-176, 1903.
- MÜLLER, Fritz (Johannes Friedrich Theodor) (1822-1897). McLachlan, R., Ent. Mo. Mag. 33:162-163, 1897; Grouvelle, A., Bull. Soc. Ent. France p. 157, 1897; A., P., Insekten-Börse 10:54-55, 1893; A., P., l. c. 14:139, 1897; von Ihering, H., P., Rev. Mus. Paulista 3:17-29, 1898; Wetcamp, W., Die Natur 13:149, 1891; Möller, A., P., Naturw. Wochenschrift 9:445-449, 617-621, 1894; l. c. 10:261-265, 1895; Haeckel, E., Jenaische Ztsch. f. Naturw. 31:156-173, 1897; Blandford, W. F. H., Anal. Soc. Cient. Arg. 45:5-13, 1898; Blandford, W. F. H., Nature 56:546-548, 1897.
- MÜLLER, Hermann (1829-1883). A., Ent. Mo. Mag. 20:118, 1883.
- MÜLLER, Johannes Peter (1801-1858). Lühe, M., B., P., Archives Parasitol. 5:95-116, 1902.
- MÜLLER, Otto Friedrich (Otho Frideric) (1730-1784). Eisel, J. N., Geschichte, Syst. und Literatur der Insecten. p. 52, 1836; Rose, H. J., New Gen. Biog. Dict. 10:257-258, 1850.
- MÜLLER-RUTZ, Jean (1854-1944). "Th.," B., P., Mitt. Schweiz. Ent. Ges. 19:204-207, 1944; Morgenthaler, O., l. c. 19:185, 1944.
- MÜNSTER, Thomas Georg (1855-1938). Natvig, R., B., P., Norsk Ent. Tidsskrift 5:49-54, 1938; Hellén, W., P., Notulae Ent. 18:70-72, 1938; A., P., Norsk Ent. Tidsskrift 3:359, 1935.
- MUIR, Frederick Arthur Godfrey (1872-1931). Swezey, O. H., et al., B., Haw. Planters' Rec. 35:205-215, 1931.
- MUIR, John (1837-1914). Grinnell, F., Jr., Ent. News 26:95-96, 1915.
- MULSANT, Etienne (1797-1880). Locard, A., B., Mem. Acad. Sci. Lyon, Cl. de Sci. 25:259-309, 1881-82.
- MUNDELL, R. C. (-1942(?)). Mickel, C. E., Ann. Ent. Soc. Amer. 36:152, 1943; Osborn, H., Fragments Ent. Hist. 2:103-104, 1946.
- MURAT, Marc (-1940). Zolotarevsky, B., Mem. Office Nat. Anti-Acridien 1:2, 1944.
- MURRAY, Andrew (1812-1878). Marseul, S. A. de., B. only, L'Abeille 21 (Les Ent. et leurs Ecrits):106-107, 1883; Kraatz, G., Deutsche Ent. Ztschr. 22:229, 1878.
- MURRAY, James (1872-1942). A., Trans. Suffolk Nat. Soc. 5(1):xxx, 1942.
- MURRAY, John Andrew (1740-1791). Rose, H. J., New Gen. Biog. Dict. 10:269, 1850.
- MURRAY-AARON, Eugene (1852-1940). A., Ward's Nat. Sci. Bull. 14(3-4):12, 1940.
- MURTFELDT, Mary Esther (1839-1913). Meiners, E. P., P., Lepidopterists' News 2:83, 1948.
- MYERS, John Golding (1897-1942). China, W. E., Nature 149:406, 1942.
- NAGEL, Paul (1859-1924). Wolf, P., Jahresh. Ver. Schles. Insektenk. Breslau 14:23-24, 1924.
- NANIOT, Louis (-1907). A., Ent. Record 19:146, 1907; Poskin, J., et al., Rev. Mens. Soc. Ent. Namuroise 7:21-22, 1907.
- NASSONOV, Nicolai Victorovich (1855-1939). Uvarov, B. P., Nature 143:549, 1939.
- NATTERER, Johann (1787-1843). Goeldi, E. A., P., Bol. Mus. Paraense 1:189-217, 1896.
- NATTERER, Leopold (-1942). Jarvis, C. M., Ent. Mo. Mag. 82:160, 1946.
- NAUFOCK, Albert (1878-1937). Alberti, B., Mitt. Münch. Ent. Ges. 27:103-104, 1937.
- NAVARRO DE ANDRADE, Edmundo (1881-1941). Borgmeier, T., P., Rev. Ent. (Brasil)

- 13:182-188, 1942; A., P., *O Biologico (Brasil)* 7:354-355, 1841; Lizer y Trelles, C. A., *Curso de Entomologia* 1:23, 1947.
- NAVAS, Longinos (1858-1938). del Cañizo, J., B., P., *Bol. Patol. Veg. y Ent. Agr.* 10:1-3, 1941; De Beaux, O., *Ann. Mus. Civ. Stor. Nat. Genova* 60(3)-(4), 1940; Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:168-172, 189, 1919.
- NEAVE, B. W. (-1923). Riley, N. D., *Proc. So. Lond. Ent. & N. H. Soc.* p. 75, 1923-24.
- NEBEL, Ludwig (1861-1911). Heidenreich, E., *Deutsche Ent. Nat. Bibliothek* 2:135-136, 1911; Kunze, A., *Internat. Ent. Ztschr.* 5:144-145, 1911.
- NECKAM, Alexander (1157-1217). Weiss, H. B., *Journ. N. Y. Ent. Soc.* 35:417-418, 1927.
- NÉCSEY, Stefan (1870-1902). A., *Rovartani Lapok (Budapest)* 9:88; 9(4):8, 1902; Aigner, L., P., *l. c.* 10:1-9; 10(1):1, 1903.
- NEEDHAM, John Turberville (1713-1781). Rose, H. J., *New Gen. Biog. Dict.* 10:298, 1850.
- NEIVA, Arthur (1880-1943). Lent, H., et al., B., *Rev. Ent. (Brasil)* 11:954-962, 1940; Travassos, L., P., *Mem. Inst. Oswaldo Cruz* 40:i-vi, 1944; Lizer y Trelles, C. A., *Curso de Entomologia* 1:22-23, 1948.
- NELSON, James Allen (1875-1941). Osborn, H., P., *Fragments Ent. Hist.* 2:104, 1946.
- NERÉN, Carl Harald (-1901). Nordenström, H., B., P., *Ent. Tidskrift* 23:195-197, 1902.
- NERESHEIMER, Julius (1880-1943). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 11:57, 1944.
- NESSLING, Eliel (1871-1941). Hellén, W., *Notulae Ent.* 23:58-59, 1943.
- NETOLITZSKY, Fritz (1875-1945). Jarvis, C. M., *Ent. Mo. Mag.* 82:160, 1946; Schedl, K. E., *Zentralbl. Gesamtgeb. Ent.* 1:95, 1946.
- NEUMANN, Caspar (Gaspar) (1683-1737). Rose, H. J., *New Gen. Biog. Dict.* 10:316, 1850.
- NEVERMANN, Guillermo Enrique Fernando (Wilhelm Heinrich Ferdinand) (1881-1938). A., P., *Rev. Agr. (Costa Rica)* 10:334-345, 1938; A., *Enciclop. Univ. (Espana)* Apéndice 7:1029-1030, 1932.
- NEVINSON, Basil George (1852-1909). Fowler, W. W., *Ent. Mo. Mag.* 46:93-94, 1910.
- NEWCOMB, Simon (1835-1909). Howard, L. O., et al., P., *Bull. Philos. Soc. Wash.* 15:133-167, 1910.
- NEWELL, Wilmon (1873-1943). Mowry, H., *Science* 99:377-378, 1944; Osborn, H., *Fragments Ent. Hist.* 2:104-105, 1946.
- NEWMAN, Leonard Woods (1873-1949). "J. A. T.," *Entomologist* 82:143-144, 1949; Cockayne, E. A., *Ent. Record* 61:80-81, 1949.
- NEWMAN, Leslie John (1878-1938). Musgrave, A., B., *Bib. Austr. Ent.* pp. 238-240, 1932; A., *Nature* 143:549, 1939.
- NEWPORT, George (1803-1854). A., B., *Proc. Linn. Soc. Lond.* 2:309-312, 1854.
- NEWSTEAD, Robert (1859-1947). A., *Science* 105:332, 1947; Laing, F., P., *Ent. Mo. Mag.* 83:109, 1947; A., P., *Ann. Trop. Med. & Parasit.* 41(1):frontispiece, 1947; A., *Nature* 159:428-429, 1947.
- NICEVILLE, Charles Lionel Augustus de (1852-1901). Holland, W. J., *Ent. News* 13:63, 1902.
- NICKERL, Ottokar (1838-1920). Heller, K. M., *Ent. Blätter* 16:256, 1920; Heller, K. M., P., *Deutsche Ent. Ztschr. Iris* 34:263-266, 1920.
- NICOLAS, Hector (1834-1899). Chobaut, A., B., *Mem. Acad. Vaucluse* 18:347-354, 1899; Barthe, E., B., *Miscellanea Ent.* 8:86-88, 1900.
- NICOLAY, Alan S. (-1950). Blackwelder, R. E., *Coleopterists' Bull.* 4:2, 1950.
- NICOLET, Hercule (-1872). Bonnet, P., *Bibliographia Araneorum* p. 35, 1945.
- NIEBUHR, Carsten (1733-1815). Rose, H. J., *New Gen. Biog. Dict.* 10:338-339, 1850.
- NIELSEN, Emil (1876-1938). Bonnet, P., P., *Bibliographia Araneorum* pp. 52-53, 1945.
- NIELSEN, Jens Christian (1881-1918). Stamm, R. H., B., P., *Vidensk. Medd. Dansk Naturh. For. (Köbenhavn)* 70:v-xi, 1919; Späcck, R., P., *l. c.* 95:110, 1933; Esben-Petersen, P., P., *Flora og Fauna* pp. 113-114, 1918; Lundbeck, W., *Natur-ens Verden* 2:284-285, 1918.
- NIEPELT, Wilhelm (1862-1936). A., P., *Festschr. Embrik Strand* 4:670-672, 1938; Röber, J., B., P., *Internat. Ent. Ztschr.* 26:327-333, 1932.

- NIEREMBERG, Johann Eusebius von (1595-1658). Rose, H. J., *New Gen. Biog. Dict.* 10:341, 1850.
- NIETO, José Apolinario (1810-1874). Sallé, A., *Ann. Soc. Ent. France* (5) 4:359-361, 1874.
- NIISIMA (NIHJIMA), Y. (-1944). Remington, C. L., *Ann. Ent. Soc. Amer.* 39:449, 1946.
- NITSCHKE, Josef (1873-1941). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 9:134, 1942.
- NITZSCH, Christian Ludwig (1782-1837). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 101-102 (footnote), 1874; Keler, S., *P., Ztschr. Parasitenk.* (Berlin) 10:31-66, 1938.
- NÖRDLINGER, Hermann (1818-1897). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 379-380, 1874.
- NONELL COMAS, Jaime (1876-1938). A., B., P., *Bol. Patol. Veg. y Ent. Agr.* (Madrid) 9:298-302, 1940.
- NORDENSKIÖLD, Adolf Erik (1832-1885). Ross, E., *Internat. Ent. Ztschr.* 27:539, 1934.
- NORDENSKIÖLD, Erik (1872-1933). Palmgren, A., *P., Mem. Soc. Fauna et Flora Fenn.* 9:209-211, 227-229, 1934.
- NORMAN, George (1824-1882). "T. S.", B., P., *Trans. Hull Club* 1:105-112, 1900.
- NOUAILHIER, Jean Maurice (-1898). Jordheuille, C., *Bull. Soc. Ent. France* p. 157, 1898; A., *Ent. Mo. Mag.* 34:165, 1898.
- NOVAK, Giam-Battista (-1893). A., *Wiener Ent. Zeit.* 13:195, 1894.
- NÜSSLIN, Otto (1850-1915). Fuchs, G., B., P., *Ent. Blätter* 7:1-5, 1911.
- NUNENMACHER, Frederick William (1870-1946). A., *Pan-Pacific Ent.* 22:70, 1946; Leach, E. R., B., P., *I. c.* 24:1-5, 1948; Essig, E. O., *P., Hist. of Ent.* pp. 717-719, 1931.
- NURSE, Charles George (1862-1933). Riley, N. D., *Entomologist* 67:23-24, 1934.
- NURSE, Euston John (1865-1945). A., *Trans. Suffolk Nat. Soc.* 5:c, 1945.
- NUTTALL, George Henry Falkiner (1862-1937). Roubaud, E., *Bull. Soc. Path. Exot.* 31:1-3, 1938; "L. R. N." *Norsk Ent. Tidsskrift* 5:91, 1938; Graham-Smith, G. S., P., *Obit. Notices Fellows Roy. Soc. (Lond.)* 2:493-499, 1939; Graham-Smith, G. S., P., *Journ. of Hygiene* 38:129-140, 1938; Graham-Smith, G. S., et al., B., P., *Parasitology* 30:403-418, 1938; A., *Nature* 141:318-319, 1938; Osborn, H., *Fragments Ent. Hist.* 2:105-106, 1946; Howard, L. O., *Pop. Sci. Monthly* 87:68, 1915.
- OBERT, Ivan Stanislovich (1809-1900). Jacobson, G., *Horae Soc. Ent. Ross.* 35:xxxvii-xxxix, 1901.
- OBERTHÜR, Charles (1845-1924). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:182, 1919.
- OBERTHÜR, Rene (1852-1944). Collart, A., *Bull. & Ann. Soc. Ent. Belg.* 81:185, 1945; Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:182, 1919.
- OCKENDEN, George Richard (1868-1906). Hartert, E., *Novitates Zool.* 14:341-342, 1907.
- OETTEL, August (1839(?) -1905). Daniel, K., *Münch. Koleopt. Ztschr.* 2:390-391, 1906.
- OGLOBLIN, Dimitri Alexeevitch (1893-1942). Stackelberg, A. A., B., *Rev. Ent. U. R. S. S.* 28:131-134, 1945.
- OHAUS, Friedrich (1864-1946). Schunk, F., *Mainzer Kalendar*, 19 pp. (Sep. of same accompanied by typewritten copy of B.), 1948; Ross, E., *Internat. Ent. Ztschr.* 27:539, 1934.
- OHLERT, Gustav Heinrich Emil (1807-1871). Bonnet, P., *Bibliographia Araneorum* p. 35, 1945.
- OLAFSSON (OLAFSEN), Eggert (1726-1768). Rose, H. J., *New Gen. Biog. Dict.* 10:382, 1850.
- OLDENBERG, Lorenz (1863-1931). Lichtwardt, B., P., *Konowia* 10:155-156, 1931.
- OLEARIUS, Adam (1599-1671). Rose, H. J., *New Gen. Biog. Dict.* 10:387-388, 1850.
- OLIVEIRA, Manuel Paulino d' (1837-1899). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:193, 1919.
- OLIVIER, Guillaume Antoine (1756-1814). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 389-390, 1874; Rose, H. J., *New Gen. Biog. Dict.*

- 10:392-393, 1850; Bonnet, P., *P., Bibliographia Araneorum* p. 30, 1945; Ross, E., *Internat. Ent. Ztschr.* 27:316, 1933.
- OLIVIER, Joseph Ernest (1844-1914). Porter, C. E., *P., Rev. Chilena Hist. Nat.* 19:56-57, 1915.
- ORBIGNY, Alcide Dessalines d' (1802-1857). von Hagen, V. W., *Green World of the Naturalists* pp. 182-200, 1948.
- ORCHYMONT, Armand d' (-1947). "L. B.," *Lambillionea* 46:117, 1946 (1947); Horion, A., *Koleopt. Zeitschrift* 1:77, 1949.
- ORD, George Walker (1871-1899). Paterson, J., *Ann. Scottish N. H.* pp. 193-196, 1899; "R. H.," *Trans. N. H. Soc. Glasgow* 5:319-321, 1896-99.
- ORMANCY, Pèdre (1811-1852). Mulsant, E., *B., P., Opusculs Ent.* 2:101-104, 1853.
- ORMEROD, Eleanor Anne (1828-1901). A., *Ent. Record* 13:280, 1901; "W. F. K.," *Nature* 64:330, 1901.
- ORMEROD, Georgina Elizabeth (1823-1896). Ormerod, A., *P., Entomologist* 29:310-311, 1896; A., *Ent. Mo. Mag.* 32:215, 1896.
- ORR, Hugh Lamont (-1913). A., *Irish Nat.* 22:115, 1913.
- ORR, James (1879-1946). "J. A. S. S.," *Irish Nat. Journ.* 8:433-434, 1946.
- ORSTADIUS, Ernst Teodor (-1939). Kemner, N. A., *Opuscula Ent.* 4:111, 1939.
- ORTONEDA, Vicente (-). Porter, C. E., *Aev. Chilena Hist. Nat.* 34:394, 1930.
- OSBORN, Henry Fairfield (1851-1935). Cooper, C. F., *Proc. Linn. Soc. Lond.* 148:209-210, 1936; Grabau, A. W., *P., Peking N. H. Bull.* 10:165-166, 1935-36; Cipriani, L., *Riv. Biol. (Firenze)* 22:196-197, 1938.
- OSMONT, Auguste E. (-1894). Fauvel, A., *Rev. d'Ent. (Caen)* 13:287, 1894.
- OTTO, Paul von (1869-1939). Hartwig, F., *Ent. Zeitschrift* 53:65-66, 1939.
- OTTOLENGUI, Rodrigues (-1937). N. Y. Times July 13, 1937.
- OUDEMANS, Anthonie Cornelis (1858-1943). van Eynthoven, G. L., *Ent. Berichten* 11:49-50, 1943; van Eynthoven, G. L., *B., P., Tijdschr. Ent.* 86:1-56, 1943; Hase, A., *P., Ztschr. Parasitenk.* 13:147-149, 1944; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 10:174, 1943.
- OVIEDO Y VALDÉS, Gonzalo Fernandez de (1478-1557). Rose, H. J., *New Gen. Biog. Dict.* 10:428-429, 1850; Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:76, 1919; von Hagen, V. W., *Green World of the Naturalists* pp. 16-30, 1948.
- OWEN, Richard (1804-1892). A., *Proc. Linn. Soc. Lond.* pp. 23-26, 1892-93; Godman, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:xlvi, 1892.
- PACK, Herbert John (1892-1930). A., *Pan-Pacific Ent.* 6:126, 1930; Cattell, J. M., *Amer. Men of Sci.* p. 743, 1927.
- PACK-BERESFORD, Denis Robert (1864-1942). Praeger, R. L., et al., *P., Irish Nat. Journ.* 8:38-40, 1942; Bonnet, P., *P., Bibliographia Araneorum* p. 54, 1945.
- PACKARD, Alpheus Spring (1839-1905). A., *P., Insekten-Börse* 22:65, 1905; Woodward, A. S., *Proc. Linn. Soc. Lond.* pp. 45-46, 1904; Kusnezov, N. J., *B., Rev. Russe Ent.* 5:189-190, 1905; Merrifield, F., *Trans. Ent. Soc. Lond. (Proc.)*:lxxxv, 1905; Remington, J. E., *Lepidopterists' News* 1:39, 1947; *P. only l. c.* 2:54, 1948.
- PAGE, H. E. (-1945). A., *Ent. Record* 57:48, 1945.
- PAGENSTECHER, Arnold (1837-1913). Lampe, E., *P., Ent. Zeitschrift* 27:72, 84, 1913; Sich, A., *Ent. Record* 25:314, 1913; Dreyer, L., *B., P., Jahrb. Nassau. Ver. Naturk.* 66:v-xvi, 1913; Lampe, E., *B. only, Ent. Zeitschrift* 28:9-10, 1914.
- PAGET, James (1814-1897). Bloomfield, E. N., *Ent. Mo. Mag.* 36:89, 1900.
- PAILLOT, André (1885-1944). Steinhaus, E. A., *Science* 102:371-372, 1945.
- PALEY, William (1743-1805). Rose, H. J., *New Gen. Biog. Dict.* 10:450-451, 1850.
- PALISOT DE BEAUVOIS, Ambroise Marie François Joseph (1752-1820). Swainson, W., *Bib. of Zool.* p. 122, 1840; Merrill, E. D., *P., Proc. Amer. Philos. Soc.* 76:899-920, 1936 (1937); Rose, H. J., *New Gen. Biog. Dict.* 10:451-452, 1850.
- PALLAS, Pierre Simon (1741-1811). Cuvier, G., *Eloges Historiques* pp. 223-256, 1835; Percheron, A., *B., Bibliog. Ent.* 1:305-306, 1837; Jardine, W., *B., P., Naturalist's Library* 18:17-76, 1848; Rose, H. J., *New Gen. Biog. Dict.* 10:454-455, 1850.
- PALMÉN, Johan Axel (1845-1919). Nordqvist, O., *P., Fauna och Flora* 14:131-139, 1919.
- PANNEWITZ, Julius von (1788-1867). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 390-393, 1874; Grunert, J. T., *Forstliche Blätter* 2:192-195, 1861.

- PANTEL, José (1853-1920). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:166-167, 1919.
- PANZER, Georg Wolfgang Franz (1755-1829). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon p. 475 (footnote), 1874; Eisinger, F., B., P., Internat. Ent. Ztschr. 13:89-92, 1919; Bonnet, P., Bibliographia Araneorum p. 30, 1945.
- PAOLI, Guido (1881-1947). Melis, A., Redia, 32:xxiii-xxiv, 1947; A., Boll. Soc. Ent. Ital. 77:1, 1947; Binaghi, G., B., P., Mem. Soc. Ent. Ital. 26:3-19, 1947.
- PARENT, Octave (1882-1942). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:133-134, 1942.
- PARKER, Samuel (1759-1825). Rose, H. J., New Gen. Biog. Dict. 10:480-481, 1850.
- PARRENIN, Dominique (1665-1742). Rose, H. J., New Gen. Biog. Dict. 10:486-487, 1850.
- PARRY, Frederick John Sidney (1810-1885). McLachlan, R., Trans. Ent. Soc. Lond. (Proc.):xli, 1885.
- PARRY, Thomas (-1872). A., Ent. Mo. Mag. 9:292, 1872.
- PASCOE, Francis Polkinghorne (1813-1893). A., P., Insekten-Börse 10:185, 1893; Elwes, H. J., Trans. Ent. Soc. Lond. (Proc.):lv-lvi, 1893.
- PASSERINI, Giovanni (1816-1893). de Toni, G. B., B., P., Boll. R. Istit. Bot. Univ. Parmense pp. 5-16, 1892-93.
- PÁSZTOR, István (1874-1909). A., Ent. Rundschau 26:45, 1909.
- PATERSON, Guillermo (-1946). Hayward, K. J., Rev. Soc. Ent. Arg. 13:343, 1947.
- PAUL, Moritz (-1898). A., Mitt. Schweiz. Ent. Ges. 10:136, 1898.
- PAUL Y AROZARENA, Manuel de (1852-1930). A., B., Bol. Patol. Veg. y Ent. Agr. 5:223-224, 1930.
- PAULMIER, Frederick Clark (1873-1906). "E. B. W.," Science 23:556, 1906.
- PAVESI, Pietro (1894-1907). Bonnet, P., P., Bibliographie Araneorum p. 41, 1945; Monti, R., Archiv. f. Hydrobiol. u. Planktonk. 4:287-295, 1909.
- PAYKULL, Gustav von (1757-1826). A., B., Kgl. Vetensk.-Acad. Handl. (Stockholm) pp. 350-358, 1826 (1827).
- PAYNE, Henry T. (-1930). A., London Nat. p. 39, 1930.
- PEALE, Titian Ramsay (1800-1885). "H. W. S.," Dict. Amer. Biog. 14:351-352, 1934.
- PEARL, Raymond (1879-1940). Greenwood, M., Nature 147:140, 1941; Miner, J. R., et al., P., Scientific Monthly 52:192-194, 1941; Reed, L. J., Science 92:595-597, 1940; A., Journ. Wash. Acad. Sci. 31:127, 1941; Greenwood, M., Ecology 22:408, 1941; P., only, Quart. Rev. Biol. 15(4), 1940.
- PECKHAM, George Williams (1845-1914). Birge, E. A., Trans. Wisc. Acad. Sci. 20:715-716, 1921; Russell, H., et al., B., P., Bull. Wisc. N. H. Soc. 11:109-112, 1913; Bonnet, P., P., Bibliographia Araneorum pp. 45-46, 1945.
- PENNANT, Thomas (1726-1798). Rose, H. J., New Gen. Biog. Dict. 11:23-25, 1850.
- PEREZ ARCAS, Laureano (1824-1894). A., Ent. Mo. Mag. 31:196, 1895.
- PERINGUEY, Louis Albert (1855-1924). A., B., P., So. African Journ. N. H. 5:1-8, 1925.
- PERRAULT, Claude (1613-1688). Rose, H. J., New Gen. Biog. Dict. 11:42-43, 1850.
- PERRET-MAISONNEUVE, A. (1866-1937). Lesne, P., Bull. Soc. Ent. France 43:8, 1938.
- PERRIER, Alfred (1809-). Moriére, J., P., Bull. Soc. Linn. Normandie (2) 2:161-171, 1867.
- PERRIER, Edmond (1844-1921). Bouvier, L. E., P., Ann. Sci. Nat. (Zool.) 17 (vol du cent.):7, 1934; de la Torre, C., Mem. Soc. Cubana Hist. Nat. 4:29-32, 1921.
- PERRIS, Jean Pierre Omer Anne Edouard (1808-1878). Marseul, S. A. de, B. only, L'Abeille 20 (Les Ent. et leurs Écrits):14-19, 1882; Marseul, S. A. de, L'Abeille 18 (Nouvelles et fait divers (2) no. 29):113-115, 1880; Pouillaude, I., P., Insecta 9:47-48, 1919.
- PERRONCITO, Edoardo (1847-1936). Ghisleni, P., P., Ann. R. Accad. Agr. Torino 79:213-221, 1936; Penso, G., P., Ann. de Parasitol. 15:86-91, 1937; Babudieri, B., P., Riv. di Parassitol. 1:81-84, 1937; Marzocchi, V., P., Riv. Biol. (Firenze) 22:360-361, 1937.
- PERROUD, Benoit Philibert (1796-1878). Mulsant, E., B., Ann. Soc. Linn. Lyon, n. s. 26:109-120, 1879.
- PESCHET, Raymond (1880-1940). Méquignon, A., Ann. Soc. Ent. France 110:369-372, 1941.

- PETERS, Hermann (-1928). Ross, E., *Internat. Ent. Ztschr.* 27:539, 1934.
- PETERS, Wilhelm Carl Hartwig (1815-1883). Dunning, J. W., *Trans. Ent. Soc. Lond. (Proc.)* xlvii, 1883.
- PETERSEN, Wilhelm (1854-1933). Eggers, F., *Zool. Anzeiger* 102:64, 1933; Hering, M., *Mitt. Deutsch. Ent. Ges.* 4:52-54, 1933; Greiffenhagen, O., et al., *B., Beitr. Kunde Estlands* 15:23-35, 1929.
- PETERSON, John B. (-1944). Leslie, J. B., *Mosquito News* 4:128, 1944.
- PETHEN, Robert W. (1877-1944). "S. A.," *B., London Nat.* 24:67, 1944.
- PETIVER, James (1660(?) -1718). Rose, H. J., *New Gen. Biog. Dict.* 11:65, 1850.
- PETROCCHI, Juana Miguela (1893-1925). Deautier, E. A., *B., P., Rev. Soc. Arg.* 3:271-274, 1931; *A., B., P., Physis (Arg.)* 7:417-420, 1925; Lizer y Trelles, C. A., *Curso de Entomologia* 1:49-50, 1947.
- PETRY, Arthur (1858-1932). Bergmann, A., *B., P., Internat. Ent. Ztschr.* 26:53-59, 1932.
- PETIT, Rufus Hiram (1869-1946). McDaniel, E. I., *P., Journ. Econ. Ent.* 39:554-555, 1946; *A., P., The Record, Mich. State Coll.* 51(3):15, 1946; Wade, J. S., et al., *Proc. Ent. Soc. Wash.* 49:87, 1947; McDaniel, E. I., *Ann. Ent. Soc. Amer.* 42:238, 1949.
- PETZ, Josef (1866-1926). Heikertinger, F., *Koleopt. Rundschau* 12:172-173, 1926.
- PEUCER, Gaspard (Casper) (1525-1602). Rose, H. J., *New Gen. Biog. Dict.* 11:72, 1850.
- PFANKUCH, Karl (1871-1924). Alfken, J. D., *B., Deutsche Ent. Ztschr.* pp. 549-553, 1924.
- PFEIL, Friedrich Wilhelm Leopold (1783-1859). Grunert, J. T., *Forstliche Blätter* 1:41, 1861; Grunert, J. T., *l. c.* 11:207-218, 1866; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 399-416, 1874.
- PFITZNER, Wenzel (-1910). *A., Ent. Rundschau* 27:54, 1910.
- PHILIPPI, Federico (1838-1910). Gotschlich, B., *B., Bol. Mus. Nac. Chile* 1 (Secc. Admin. i Estad.):39-80, 1910; Moore, E., *l. c.* 2:264-298, 1910; *A., P., l. c.* 3:235-272, 1911; Porter, C. E., *B., P., Rev. Chilena Hist. Nat.* 43:10-15, 1939; Porter, C. E., *B., P., Rev. Universitaria* 24:5-9, 1939; Porter, C. E., *B., P., Anal. Soc. Cient. Arg.* 69:147-149, 1910; *A., Ent. Rundschau* 27:46, 1910; Lizer y Trelles, C. A., *Curso de Entomologia* 1:24, 1947.
- PHILIPPI, Rodolfo Amando (1808-1904). Stuardo, C., et al., *P., La enseñanza a de las ciencias naturales en los liceos. Bosquejo historico 1797-1900, pub. by Mus. Pedagógico de Chile* pp. 47-57, 1944; Gotschlich, B., *B., P., Biografía del Dr. Rodolfo Amando Philippi, Santiago*, 184 pp., 1904; *A., Insekten-Börse* 21:266-267, 1904; "B. D. J.," *Proc. Linn. Soc. Lond.* pp. 47-49, 1904; Lizer y Trelles, C. A., *Curso de Entomologia* 1:24, 1947; Barros, R., *El Dr. Rodolfo Amando Philippi, su vida y sus obras*, Santiago, 248 pp., 1904.
- PHILLIPS, Robert Allen (1866-1945). "A. W. S.," *P., Irish Nat. Journ.* 8:391-394, 1946.
- PIAGET, Edouard (1817-1910). Jacobson, G. G., *Rev. Russe Ent.* 11:313, 1911.
- PICKARD-CAMBRIDGE, Frédéric Octavius (1860-1905). Bonnet, P., *P., Bibliographia Araneorum* p. 52, 1945.
- PICKARD-CAMBRIDGE, Octavius (1828-1917). Bonnet, P., *P., Bibliographia Araneorum* pp. 38-39, 1945.
- PICET, Arnold (1869-1948). "L. B., Lambilliona" 48:49, 1948; Romieux, J., *P., Mitt. Schweiz. Ent. Ges.* 21:566-570, 1948.
- PICET, A. Edouard (1835-1879). *A., Nature* 20:88, 1879.
- PIEPERS, Marinus Cornelis (-1919). Martin, L., *Deutsche Ent. Ztschr., Iris* 33:134-135, 1913.
- PIERCE, Frank Nelson (1861-1943). Mansbridge, W., et al., *P., Northwestern Nat.* 18:228-231, 1943.
- PIERSIG, Gustav Richard (1857-1906). *A., P., Insekten-Börse* 23:169, 1906; Krancher, O., *P., Ent. Jahrbuch* 17:204, 1908.
- PIESBERGEN, Franz (1860-1928). Reihlen, M., *Jahresh. Ver. Väterl. Naturk. Würt.-temb.* 84:xxxiv, 1928.
- PIFFARD, Albert (-1909). Morley, C., *Entomologist* 43:127-128, 1910.
- PIGG, Thomas (-1901). *A., Ent. Record* 14:27, 1902.

- PIGNORIA (PIGNORIUS), Lorenzo (Laurentius) (1591-1631). Rose, H. J., New Gen. Biog. Dict. 11:114-115, 1850.
- PINCOMBE, Torrington Hawke (1867-1947). Osborne, G. D., Proc. Linn. Soc. N. S. Wales 73:i-ii, 1948.
- PINGERON, Jean Claude de (1730-1795). Rose, H. J., New Gen. Biog. Dict. 11:120, 1850.
- PIOCHARD DE LA BRULERIE, Charles Jacob (1845-1876). Marseul, S. A. de, L'Abeille 24 (Les Ent. et leurs Ecrits):179-180, 1887.
- PLASON, Victor (1843-1904). A., Insekten-Börse 21:354, 1904; A., Wiener Ent. Zeit. 23:181, 1904; Ross, E., Internat. Ent. Ztschr. 27:540, 1934.
- PLATEAU, Félix (1841-1911). Lambillion, L. J., Rev. Soc. Ent. Namuroise 11:26-27, 1911; Mercanton, P. L., Bull. Soc. Vaudoise Sci. Nat. 47 (Procès-Verbaux):xxxvii, 1911; Jacobson, G. G., Rev. Russe Ent. 11:313-314, 1911.
- PLATH, Otto Emil (1885-1940). A., Science 92:474, 1940; Osborn, H., Fragments Ent. Hist. 2:106, 1946.
- PLATONOFF, Stephan (1917-1944). Palmén, E., B., P., Ann. Ent. Fenn. 10:148-151, 155-156, 1944; Lindberg, H., P., Notulae Ent. 24:105-106, 1944.
- PLATT-BARRETT, J. (-1916). Moore, H. Ent. Record 29:43-44, 1917.
- PLINY (Caius Plinius Secundus) (23-79). Rose, H. J., New Gen. Biog. Dict. 11:159-161, 1850; Mair, A. W., Encycl. Britannica, 14th ed. 18:77-78, 1938; Eiselt, J. N., Geschichte, Syst. und Literatur der Insecten. pp. 11-12, 1836; Percheron, A., B., Bibliog. Ent. 1:317-319, 1837; Schenkling, S., Illustr. Wochenschr. 2:1-6, 1897; Harvey, P., Oxford Companion to Classical Lit. pp. 334-335, 1940.
- PLOT, Robert (1640-1696). Rose, H. J., New Gen. Biog. Dict. 11:162, 1850.
- PLUCHE, Noël Antoine (1688-1761). Rose, H. J., New Gen. Biog. Dict. 11:163-164, 1850.
- PLUMIER, Charles (1646-1704). Rose, H. J., New Gen. Biog. Dict. 11:164, 1850.
- POCOCK, Reginald Innes (1863-1947). Hindle, E., Nature 160:322-323, 1947; Bonnet, P., P., Bibliographia Araneorum p. 54, 1945.
- PODA VON NEUHAUS, Nicolaus (1723-1798). Ambrosi, F., Bull. Soc. Veneto-Trent. Sci. Nat. (Padova) 4:150, 1889.
- POEY, Felipe (1799-1891). Mestre, A., P., Mem. Soc. Cubana Hist. Nat. 1:3-8, 1915; Mestre, A., P., I. c. 4:15-28, 1921; Lizer y Trelles, C. Aa., Curso de Entomologia 1:28, 1947.
- POKORNY, Emanuel (-1900). Mik, J., Wiener Ent. Zeit. 19:136, 1900.
- POLINSKI, Wladyslaw (1885-1930). Jaczewski, T., Polskie Pismo Ent. 9:289-292, 1930.
- POMINI, Francesco Pio (1915-1941). De Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 61:(3), 1943.
- PONTERA, Guilio (1688-1757). Rose, H. J., New Gen. Biog. Dict. 11:192, 1850; Weiss, H. B., et al., Ent. News 34:11-16, 41-44, 1923.
- POPENOE, Charles Holcomb (1884-1933). Wade, J. S., Auk 54:573, 1937; Who's Who in the East, p. 1664, 1930; Who's Who in the Nation's Capital, p. 733, 1933-34.
- PORTER, Carlos Emilio (1868-1942). Caro, V. E., et al., Rev. Acad. Colombiana de Cienc. 3:195, 1939; Gigoux, E. E., Bol. Mus. Nac. Hist. Nat. (Chile) 20:107-108, 1942; A., Physis 9:155-156, 1928; A., P., Rev. Chilena Hist. Nat. 45:7-9, 1941 (1943); Birabén, M., P., Rev. Mus. La Plata (N.S.) Secc. Ofic. pp. 133-135, 1943; Liza y Trelles, C. A., Curso de Entomologia 1:26-27, 1947.
- PORTSCHINSKY, Josifa Aloizievich (1848-1916). Carpenter, G. D. H., Proc. Roy. Ent. Soc. Lond. (A) 22:103-113, 1947.
- POTTER, W. R. R. (-1939). Swezey, O. H., Proc. Haw. Ent. Soc. 10:455, 1940.
- POUJADE, Gustave Arthur (-1909). A., Ent. Rundschau 26:115, 1909.
- POULTON, Edward Bagnall (1856-1943). Turner, H. J., Ent. Record 56:40, 1944; Carpenter, G. D. H., Ent. Mo. Mag. 80:24, 1944; Carpenter, G. D. H., B., P., Obit. Notices Fellows Roy. Soc. Lond. 4:655-680, 1944; Carpenter, G. D. H., Nature 153:15-17, 1944; Carpenter, G. D. H., Oxford Mag. 62:115-116, 1944.
- POUPART, François (1661-1709). Rose, H. J., New Gen. Biog. Dict. 11:215, 1850.
- PRAHWE, Konstantin Konstantinovich (1868-1910). Lutshnik, V., P., Rev. Russe Ent. 11:309-310, 1911.
- PRATT, Benjamin G. (1862-1947). A., P., Journ. Econ. Ent. 41:840-841, 1948.

- PREISS, Paul (1859-1937). Schultze-Rhonhof, A., *Deutsche Ent. Ztschr. Iris* 52:4-49, 1938.
- PRESL, Johann Swatopluk (1791-1849). Eiselst, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 92-101, 1836.
- PREST, William (1824-1884). Carrington, J. T., *Entomologist* 17:119-120, 1884.
- PRESTON, Thomas Arthur (-1905). A., *Rpt. Marlborough Coll. N. H. Soc.* 53:101-104, 1905.
- PREUDHOMME DE BORRE, François Paul Charles Alfred (1833-1905). A., *P., Insekten-Börse* 22:49, 1905; Le Royer, A., *Mém. Soc. Phys. et Hist. Nat. Genève* 35:141-143, 1906.
- PREYSSLER, Johann Daniel Eduard (-). Eiselst, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 64-65, 1836.
- PRINGLE, John (1707-1782). Rose, H. J., *New Gen. Biog. Dict.* 11:231-232, 1850; A., *B., Encyclop. Britannica*, 14th ed. 18:498, 1938.
- PRINSEPS, James (1800-1840). Rose, H. J., *New Gen. Biog. Dict.* 11:232-233, 1850.
- PRINZ, Johann (1845-1934). "R., P., *Ztschr. Österr. Ent.-Ver.* 19:41-42, 1934.
- PROFFT, Joachim (1911-1942). Köhler, E., *P., Arb. Physiol. Angew. Ent. Berlin-Dahlem* 9:135-136, 1942.
- PROHASKA, Karl (1854-1937). Ruschnig, R., *Carinthia II*, 48:136-138, 1938.
- PROPER, Argyle B. (1905-1933). Jones, T. H., *Journ. Econ. Ent.* 27:296-297, 1934; Jones, T. H., *Psyche* 41:49, 1934; Hungerford, H. B., *Ann. Ent. Soc. Amer.* 27:123, 1934.
- PROUT, Louis Beethoven (1864-1943). "J. A. S., *Lond. Nat. for* 1943 pp. 46-48, 1944; Cockayne, E. A., *Lond. Nat. for* 1945 pp. 16-23, 1946.
- PROVANCHER, Léon (1820-1892). A., *Ent. Mo. Mag.* 28:247, 1892; Huard, V. A., *Nat. Canadien* 21:38-41, 53-58, 85-88, 101-104, 134-137, 148-152, 182-185, 1894; 22:18-22, 53-57, 117-120, 133-136, 181-185, 1895; 23:49-53, 81-84, 113-117, 145-148, 177-180, 1896; 24:178-180, 1897; 25:34-37, 52-56, 82-86, 115-118, 133-136, 168-172, 183-187, 1898; 26:17-21, 41-44, 81-85, 138-142, 151-152, 162-165, 178-182, 1899.
- PRYER, Henry James Stovin (1850-1888). Carrington, J. T., *Entomologist* 21:167-168, 1888; A., *Leopoldina* 24:109, 1888.
- PRYER, William Burgess (1843-1899). Janson, O. E., *Entomologist* 32:52, 1899.
- PÜNGELER, Rudolf (1857-1927). Schawerda, K., *P., Ztschr. Österr. Ent.-Ver.* 41:42, 1927.
- PUGA BORNE, Federico (1856-1935). Porter, C. E., *P., Rev. Chilena Hist. Nat.* 39:305-312, 1935.
- PUIG Y VALLS, Rafael (1845-1920). Marqués de Campo, *Mem. R. Acad. Cienc. y Artes Barcelona* 18:209-218, 1924.
- PULKINEN, Antti Arman (Asko) (1885-1933). Palmgren, A., *P., Mem. Soc. Fauna et Flora Fenn.* 9:208-209, 225-227, 1933.
- PULLEINE, Robert Henry (1869-1934). "B. S. R., et al., *B., P., Trans. & Proc. Roy. Soc. So. Austr.* 59:v-vi, 1935.
- PULS, Jacques Charles (-1889). A., *Ent. Mo. Mag.* 25:262, 1889; Laboulbène, A., *Ann. Soc. Ent. France* (6) 9 (Bull.):lxix, 1889; Walsingham, T. de G., *Trans. Ent. Soc. Lond. (Proc.):* lxxvii, 1889.
- PULTENEY, Richard (1730-1801). Rose, H. J., *New Gen. Biog. Dict.* 11:250, 1850.
- PUNGUR, Julius (1843-1907). Csiki, E., *B., P., Rovartani Lapok (Budapest)* 14:93-95; 14(5-6):5, 1907.
- PURCELL, William Frederick (1866-1919). Bonnet, P., *P., Bibliographia Araneorum p.* 62, 1945.
- PURCHAS, Samuel (1575-1626). Rose, H. J., *New Gen. Biog. Dict.* 11:251, 1850; A., *B., Encyclop. Britannica* 14th ed. 18:776, 1938.
- PUTNAM, Joseph Duncan (1855-1881). Riley, C. V., *Amer. Nat.* 16:65, 1882.
- PUTON, Jean Baptiste Auguste (1834-1913). A., *Ent. Mo. Mag.* 49:278, 1913.
- PUTZEYS, Jules Antoine Adolphe Henri (1809-1882). A., *Ent. Mo. Mag.* 18:215-216, 1882; Marseul, S. A. de, *B. only, L'Abeille* 21 (Les Ent. et leurs Ecrits):102-106, 1883.
- PYETT, Claude A. (-1903). A., *Insekten-Börse* 20:1903; A., *Entomologist* 36:296, 1903.

- QUAIL, Ambrose (-1905). A., *Insekten-Börse* 22:166, 1905; A., *Entomologist* 38:264, 1905; Tutt, J. W., *Ent. Record* 17:304, 1905.
- QUATREFAGES DE BRÉAU, Jean Louis Armand de (1810-1892). A., *Leopoldina* 28:55, 1892; Jourdeuille, C., *Ann. Soc. Ent. France*, 61 (Bull.):v, 1892; A., *Insekten-Börse* 9(6):unpaged, 1892; Boucard, A., *Hummingbird* 2:133, 1892.
- QUEDENFELDT, Friedrich Otto Gustav (1817-1891). Kolbe, B., P., *Berliner Ent. Ztschr.* 37:241-246, 1892; A., *Insekten-Börse* 8(23):unpaged, 1891; P., only, *l. c.* 9(8):unpaged, 1892.
- QUILIS PÉREZ, D. Modesto (1904-1938). Sachtleben, H., *Arb. Physiol. Angew. Ent.* 8:212, 1941.
- QUIMBY, Moses (1810-1875). Elwood, P. H., *Bee-Keepers Mag.* 4:145-147, 1876; Pellett, K. L., P., *Amer. Bee Journ.* 69:450-451, 1929.
- RACK, Edmund (1735-1787). Rose, H. J., *New Gen. Biog. Dict.* 11:273, 1850.
- RADDE, Gustave Ferdinand Richard (1831-1903). von Adelung, N., *Zool. Zentralbl.* 10:829-831, 1903; Blasius, R., B., P., *Journ. Ornithol.* 52:1-49, 1904; Reichenow, A., *Ornithol. Zentralbl.* 4:14, 1879; A., P., *Globus* 25:22-24, 1874; Jacobi, A., *Naturw. Rundschau* 18:309-311, 1903; Daniel, K., *Münch. Koleopt. Ztschr.* 2:93, 1904.
- RADEMACHER, Paul (1843-1906). Dittrich, R., *Ztschr. Ent. (Breslau)* 32:L, 1907.
- RAFINESQUE, Constantine Samuel (1783-1840). Dall, W. H., *Proc. Biol. Soc. Wash.* 4:114-118, 1886-88; von Hagen, V. W., P., *Natural History*, (Amer. Mus. N. H.) 61:296-303, 1947; Jordan, D. S., *Pop. Sci. Mo.* 29:212-221, 1886; Keep, J., *West Amer. Scientist* 2:99-102, 1886; Pennell, F. W., *Transylvania Coll. Bull.* 13(7):10-70, 1942; Brendel, F., *Amer. Nat.* 13:764-765, 1879; Osborn, H., *Fragments Ent. Hist.* 2:155-157, 1946; Weiss, H. B., *Rafinesque's Kentucky Friends*, Heartman's Hist. Ser. no. 49, 71 pp., 1936.
- RAGONOT, Emile Louis (1843-1895). Mabilie, P., *Ann. Soc. Ent. France* 64 (Bull.):cccxxxix-cccl, 1895.
- RAILLIET, Alcide (1852-1930). A., *Journ. Parasitol.* 17:166, 1931.
- RAIMONDI, Antonio (1826-1890). Macedo, C. M., P., *Bol. Mus. Hist. Nat. "Javier Prado"* (Peru) 4:431-443, 1940.
- RAINBOW, William Joseph (1856-1919). Bonnet, P., P., *Bibliographia Araneorum* p. 47, 1945.
- RAMBOUSEK, Frantisek G. (1886-1931). Gradojevic, M., P., *Acta Soc. Ent. Jugoslav.* 5-6:5-7, 1930-31; Stranak, F., B., P., *Ochrana Rostlin* (Prague) 11:145-150, 1931.
- RAMBUR, Jules Pierre (1801-1870). Marseul, S. A. de, B., only, *L'Abeille* 21 (Les Ent. et leurs Ecrits):100-101, 1883; Wallace, A. R., *Trans. Ent. Soc. Lond.* (Proc.):liiii, 1871.
- RANSOM, Edward (-1946). A., *Trans. Suffolk Nat. Soc.* 6:lxv, 1947.
- RASCH, Halvor Heyerdahl (1805-1883). Natvig, L. R., P., *Norsk Ent. Tidsskrift* 7:7-10, 1944.
- RASCHKE, Johann Gottfried (1763(?) -1815). Fischer, K. von, *Germa's Mag. der Ent.* 2:343-344, 1817.
- RASPAIL, Xavier (1840-1926). Petit, L., P., *Bull. Soc. Zool. France* 52:33, 1927.
- RATHKE, Jens (1769-1855). Natvig, L. R., P., *Norsk Ent. Tidsskrift* 7:4-5, 1944; Henriksen, K. L., *Ent. Meddel.* 15:152-153, 1925.
- RATZBURG, Julius Theodor Christian (1801-1871). Ratzburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 421-429, 1874.
- RAU, Phil (1885-1948). Meiners, E. P., *Lepidopterists' News* 2:62, 1948.
- RAY (WRAY), John (1628-1705). Rose, H. J., *New Gen. Biog. Dict.* 11:299-300, 1850; A., B., *Encyclop. Britannica*, 14th ed. 18:1003, 1938; Eiselt, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 28-29, 1836.
- REAKIRT, Tryon (-). Essig, E. O., *Hist. of Ent.* p. 737, 1931; Strecker, H., B., *Butterflies & Moths of N. A.* p. 262, 1878.
- RÉAMUR, René Antoine Ferchault de (1683-1757). Eiselt, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 30-31, 1836; Nordenskiöld, E., *Hist. of Biol.* pp. 231-232, 1935; Ratzburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 429-431, 1874; Wheeler, W. M., B., P., *Nat. Hist. of Ants*, 280 pp., 1926; Rose, H. J., *New Gen. Biog. Dict.* 11:302-303, 1850; A., *Encyclop. Britannica*, 14th

- ed. 19:8, 1938; Pellett, K. L., *P.*, Amer. Bee Journ. 69:291-293, 1929; Lizer y Trelles, C. A., *Curso de Entomologia* 1:8-9, 1947.
- REBEL, Hans (1861-1940). *Natvig*, L. R., Norsk Ent. Tidsskrift 3:4, 1932; Pia, J., *Almanach Akad. Wiss. Wien* 90:204-207, 1940 (1941); Nordman, A. F., *Notulae Ent.* 20:72-73, 1941; Schima, C., *P.*, Ztschr. Österr. Ent. Ver. 16:65-70, 1931; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 7:169, 1940.
- RECLAIRE, August (1881-1949). van der Wiel, P., *B.*, *P.*, Ent. Berichten 12:409-413, 1949.
- REDI, Francesco (1626-1698). Rose, H. J., *New Gen. Biog. Dict.* 11:303, 1850; Guiart, J., *B.*, *P.*, *Archives de Parasitol.* 1:420-441, 1898; Eiselt, J. N., *Geschichte, Syst. und Literatur der Insektenk.* p. 22, 1836.
- REDLICH, Hermann Julius Albert (1842-1903). Hoffmann, P., Ent. Zeitschrift 16:85, 1903; *A.*, *P.*, *I. c.* 17:5, 1903.
- REED, Edwyn Carlos (1841-1910). Porter, C. E., *B.*, *Rev. Chilena Hist. Nat.* 7:138-141, 1903; Porter, C. E., *B.*, *P.*, *I. c.* 45:117-129, 1941 (1943); Lizer y Trelles, C. A., *Curso de Entomologia* 1:24-25, 1947.
- REED, Walter C. (1851-1902). Patterson, R. U., *Amer. Journ. Pub. Health* 23:1127-1134, 1933; Russell, F. F., *I. c.* 24:1-7, 1934; Howard, L. O., *P.*, *Pop. Sci. Monthly* 87:176, 1915.
- REGEL, Eduard August von (1815-1892). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 431-434, 1874.
- REGNELL, Anders Frederik (1807-1884). Sandahl, O. T., Ent. Tidskrift 5:191-192, 228, 1884.
- REH, Ludwig, (1867-1940). Escherich, K., et al., *Anz. f. Schädlingk.* 16:133, 1940; Heikertinger, F., *Koleopt. Rundschau* 26:93, 1940; Weidner, H., *P.*, *Anz. f. Schädlingk.* 13:45-47, 1937; *A.*, *P.*, *Ztschr. f. angew. Ent.* 24:655, 1938; *A.*, *Zool. Anzeiger* 132:195, 1940; Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 8:68-69, 1941.
- REICHE, Louis Jerome (1799-1890). Bourgeois, J., *Ann. Soc. Ent. France* (6) 10 (Bull.):lxxxviii-xc, 1890.
- REICHERT, Alexander (1859-1939). van Emden, F., *B.*, *P.*, *Ztschr. wiss. Insekten-biol.* 24:1-10, 1929.
- REICHLIN-MELDEGG, Gustav (-1880). von Harold, E., *Mitt. Münch. Ent. Ver.* 4:175, 1880.
- REIMARUS, Hermann Samuel (1694-1768). Rose, H. J., *New Gen. Biog. Dict.* 11:307-308, 1850; *A.*, *Encyclop. Britannica*, 14th ed. 19:79, 1938.
- REIMOSER, Eduard (1864-1940). Heikertinger, F., *Koleopt. Rundschau* 26:92, 1940; Pesta, O., *B.*, *P.*, *Ann. Naturh. Mus. Wien* 51:5-7, 1940; Bonnet, P., *P.*, *Bibliographia Araneorum* p. 59, 1945.
- REINECK, Georg (1882-1937). Korschefsky, R., *B.*, *P.*, Ent. Blätter 33:466-469, 1938.
- REINHARD, Hermann (1816-1892). *A.*, *P.*, *Insekten-Börse* 9 (2):unpaged, 1892.
- REINHARDT, Johannes Theodor (1816-1882). Spärck, R., *P.*, *Vidensk. Medd. Dansk Naturh. For. Kopenh.* 95:63, 1933.
- REISS, R. A. (1875-1929). Gradojevic, M., *P.*, *Acta Soc. Ent. Jugoslav* 5-6:3-5, 1930-31.
- REISSIG, Jacob (1800-1860). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 434-435, 1874.
- REITTER, Edmund (1845-1920). Fleischer, A., et al., *P.*, Ent. Nachrichtenbl. 3:1-2, 1929; Hetschko, A., *I. c.* 3:38-41, 1929; "H. B." Ent. Blätter 11:262, 1915; Hubenthal, W., *P.*, *I. c.* 16:144-145, 1920; Hetschko, A., *B.* only, *Wiener Ent. Zeit.* 41:158-162, 1924.
- REPPERT, Roy R. (1881-1940). Osborn, H., *Fragments Ent. Hist.* 2:107, 1946.
- RETZIUS, Andreas Johann (1742-1821). Eiselt, J. N., *Geschichte, Syst. und Literatur der Insektenk.* p. 46, 1836.
- RETZIUS, Gustav (1841-1919). *A.*, *Kungl. Svenska Vetensk. Akad. Aarsbok* pp. 239-243, 1922.
- REUTTI, Carl (1830-1894). Guth, F., *P.*, Arch. Insektenk. Oberheingeb. 1:193-196, 1925.
- REVELIÈRE, Eugène (1822-1892). *A.*, *Insekten-Börse*, 9 (9):unpaged, 1892; Rey, C., *L'Échange Rev. Linn.* 8:31-32, 1892.

- REVERDIN, Jacques (1842-1929). *A.*, Ent. Rundschau 46:12, 1929; Pictet, A., *B.*, *P.*, Bull. Soc. Lepidopt. Genève 6:63-88, 1929.
- REY, Claudius (1817-1895). *A.*, Ent. Mo. Mag. 31:122-123, 1895; Meldola, R., Trans. Ent. Soc. Lond. (Proc.):lxxii, 1895.
- REY, Eugène (1866-1949). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 8:287, 1941.
- RIBBE, Carl (1860-1934). Heller, K. M., *B.*, *P.*, Iris 48:138-143, 1934.
- RIBBE, Heinrich (1832-1898). Schopfer, E., Iris 11:401, 1898; *A.*, *P.*, Insekten-Börse 15:19, 1898.
- RICHARD, Louis Claude Marie (1754-1821). Larousse, P., Grand Dict. Univ. du xix Siècle 13:1182, 1865-76; Lasègue, A., Mus. Bot. B. Delessert p. 474, 1845.
- RICHARDSON, A. W. (-1948). Williams, C. B., Proc. Roy. Ent. Soc. Lond. (C) 13:68, 1948-49.
- RICHELMANN, Georg. (1851-1924). Schulze, A., Iris 38:273-278, 1924.
- RIEDEL, Max Paul (1870-1941). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 8:76, 1941.
- RIES, Erich (1908-1944). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 11:141, 1944.
- RIESEN, August (1840-1910). Ziegler, F., Berliner Ent. Ztschr. 55:264, 1910.
- RIFFARTH, Heinrich (1860-1908). *A.*, Ent. Zeitschrift 21:241, 1908.
- RILEY, Charles Valentine (1843-1895). *A.*, Arxius Escola Sup. Agr. (Barcelona), n. s. 1:599-601, 1934-35; Miller, D., Pan-Pacific Ent. 22:28-30, 1946; Remington, J. E., Lepidopterists' News 1:56, 1947; *P.* only, *I. c.* 2:54, 1948; Peattie, D. C., *P.*, Nature Mag. 23:136-137, 1934; Johnson, W. G., *P.*, Maryland Agr. Exp. Sta. Bull. 57:2-3, 1898.
- RINGSSELLE, Gustaf Alfred (1868-1944). Klefbeck, E., *P.*, Ent. Tidsskrift 66:65-67, 1945.
- RIS, Friedrich (Fritz) (1867-1931). Valle, K. J., *P.*, Notulae Ent. 12:28-31, 1932.
- RITSCHL, Julius (-1899). Hering, E., Stettiner Ent. Zeit. 60:355-356, 1899.
- RITTER, Carl (1779-1859). Kramer, P. M., Ritter's Leben, 2nd ed., Halle, 1875.
- RIVERA, Manuel Jesús (1875-1910). Porter, C. E., *B.*, *P.*, Rev. Chilena Hist. Nat. 14:254-258, 1910; Lizer y Trelles, C. A., Curso de Entomologia 1:27, 1947.
- RIVERS, James John (1824-1913). Essig, E. O., *P.*, Hist. of Ent. pp. 746-747, 1931.
- RIVINUS, Augustus Quirinus (1652-1723). Rose, H. J., New Gen. Biog. Dict. 11:356, 1850.
- RIZAL Y ALONZO, José (1861-1896). Bantug, J. B., et al., *P.*, Spec. Suppl. Bull. Bur. Health (Manila) 22(6):1-38, 1946.
- ROBBINS, Randolph William (1871-1941). "J. A. S.," et al., *B.*, *P.*, London Nat., 1941 pp. 2-11, 1942.
- ROBERT, Nicolas (1610-1684). Rose, H. J., New Gen. Biog. Dict. 11:357, 1850.
- ROBERTS, J. E. H. (-1948). Williams, C. B., Proc. R. Ent. Soc. Lond. (C) 13:68, 1948-49.
- ROBERTSON, William Rees Brebner (1881-1941). Nabours, R. K., Science 95:113-114, 1942.
- ROBINSON, Arthur (-1948). Edelsten, H. M., Entomologist 81:288, 1948; Williams, C. B., Proc. R. Ent. Soc. Lond. (C) 13:68, 1948.
- ROBINSON, E. W. (1835-1877). *A.*, Ent. Mo. Mag. 14:118-119, 1877.
- ROBINSON, Frank Edward (-1886). McLachlan, R., Trans. Ent. Soc. Lond. (Proc.):lxviii, 1886.
- ROBINSON, Herbert Christopher (1874-1929). "C. B. K.," *B.*, Journ. Fed. Malay States Mus. 16:1-12, 1930.
- ROBINSON, Jesse Mathews (1889-1949). *A.*, Journ. Econ. Ent. 42:869, 1949; *A.*, *P.*, Journ. Econ. Ent. 42:1000, 1949.
- ROBINSON, Tancred (-1748). Rose, H. J., New Gen. Biog. Dict. 11:364, 1850.
- ROBSON, John Emmerson (1833-1907). *A.*, Ent. Record 19:99, 1907; Porritt, G. T., Ent. Mo. Mag. 43:88-89, 1907.
- ROCCI, Ubaldo (1910-1943). De Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 62:(6)-(7), 1945.
- ROCQUIGNY-ANDANSON, Guillaume Charles de (1852-1904). Abbé Pierre, Rev. Sci. Bourbonnais 17:141-143, 1904.

- RODRIGUES LIMA, Juan J. (1840-1916). Lameere, A., *Ann. Soc. Ent. Belg.* 59:141, 1920.
- ROEBUCK, William Denison (1851-1919). Porritt, G. T., *Ent. Mo. Mag.* 55:91-92, 1919; Taylor, J. W., *Journ. Conch.* 16:37-39, 1919; Taylor, J. W., *P. only*, *Mono. Land & Freshwater Mollusca Br. Isles*, 1905.
- ROEDING, George Christian (1868-1928). "G. H. H.," *P.*, *Calif. State Dept. Agr. Mo. Bull.* 17:383, 1928.
- RÖHRL, Anton (1891-1944). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 11:141, 1944.
- RÖMER, Fritz (1866-1909). Brauer, A., *P.*, *Fauna Artica* 5(1):i-iii, 1910.
- RÖRIG, Georg (1864-1941). Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 8:212, 1941.
- ROESSEL VON ROSENHOF, August Johann (1705-1759). Eiselt, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 33-35, 1836; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 440-441, 1874; Eisinger, F., *Internat. Ent. Ztschr.* 3:203-204, 1909.
- RÖSNER, Joseph (1860-1920). Hedwig, K., *Jahresh. Ver. Schles. Insektenk. Breslau* 13:23, 1921.
- ROLFS, Peter Henry (1865-1944). Watson, J. R., et al., *B., P.*, *Florida Ent.* 27:1-4, 1944; Osborn, H., *P.*, *Fragments Ent. History* pp. 223-224, 1937; Osborn, H., *l. c.* 2:107-108, 1946.
- ROMAN, Per Abraham (1872-1943). Lundblad, O., *B., P.*, *Ent. Tidskrift* 65:39-45, 1944; Natvig, L. R., *Norsk Ent. Tidsskrift* 7:137, 1944; Hellén, W., *Notulae Ent.* 24:104-105, 1944; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 11:58, 1944.
- ROMANES, George John (1848-1894). *A.*, *Ent. Record* 5:176, 1894.
- RONDELET, Guillaume (1507-1566). Rose, H. J., *New Gen. Biog. Dict.* 11:382, 1850.
- RONDOUT, J. P. (-1935). Fage, L., *Bull. Soc. Ent. France* 41:8, 1936; Schuler, L., *Miscellanea Ent.* 37:13-14, 1936.
- ROOS, Karl (1908-1942). Schneider-Orelli, O., *B., P.*, *Mitt. Schweiz. Ent. Ges.* 18:530-531, 1943; Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 10:260, 1943.
- ROOT, Amos I. (1839-1923). Pellett, F. C., *Amer. Bee Journ.* 63:292, 1923; *A.*, *Gleanings in Bee Culture* 6:377, 411, 1923; Pellett, K. L., *P.*, *Ohio Farmer* 177:321, 1936.
- ROOT, Francis Metcalf (1889-1934). Hegner, R., *B., P.*, *Journ. Parasitol.* 21:67-69, 1935; *A.*, *l. c.* 20:342, 1934.
- ROOT, Lyman C. (1840-1928). *A.*, *Amer. Bee Journ.* 68:497, 1928.
- ROSELLE, Eugène Jean Baptiste Fernand du (1854-1904). Hautefeuille, P., *Bull. Soc. Linn. Nord de la France* 17:131-136, 1905.
- ROSENBERG, Einar Carl (1875-1946). Tuxen, S. L., *B., P.*, *Ent. Meddelelser* 25:144-148, 1947.
- ROSENFELD, Arthur Hinton (1866-1942). Lizer y Trelles, C. A., *Curso de Entomologia* 1:39, 1947; Osborn, H., *P.*, *Fragments Ent. Hist.* 2:108, 1946.
- ROSENHAUER, Wilhelm Gottlob (1813-1881). Marseul, S. A. de, *B. only*, *L'Abeille* 24 (Les Ent. et leurs Ecrits):190-191, 1887.
- ROSENKRANTZ, Hans Frederik (1822-1905). Engelhart, C., *P.*, *Ent. Meddelelser* 12:21-22, 1918.
- ROSS, Ronald (1857-1932). Watson, M., *P.*, *Science Progress* 27:377-395, 1933; Wenyon, C. M., *P.*, *Trans. R. Soc. Trop. Med. & Hyg.* 26:473-478, 1933; Howard, L. O., *P.*, *Pop. Sci. Monthly* 87:67, 1915.
- ROSSI, Gustav de (-1903). *A.*, *Wiener Ent. Zeit.* 22:36, 1903.
- ROSSMÄSSLER, Emil Adolf (1806-1867). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 441-446, 1874.
- ROSSUM, Arend Johan van (1842-1909). Oudemans, J. T., *P.*, *Tijdschr. Ent.* 53:1-7, 1910.
- ROSTRUP, Sofie (1857-1940). Tullgren, A., *P.*, *Tidskrift* 61:140-142, 1940; Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 7:80, 1940; Henriksen, K. L., *P.*, *Ent. Meddelelser* 20:65-66, 1938; "T. H. S.," *Norsk Ent. Tidsskrift* 6:48-49, 1941; Sachtleben, H., *Notulae Ent.* 23:59, 1943.

- ROTH, Carl David Emanuel (1831-1898). Trybom, F., *P.*, Ent. Tidskrift 19:187-189, 1898.
- ROTHSCHILD, Lionel Walter (1868-1937). Jordan, K., *Nature* 140:574, 1937; *A.*, *Auk* 55:162, 1938; Sclater, B., *P.*, *Ibis* (14) 2:111-118, 1938; Jordan, K., *P.*, *Obit. Notices Fellows Roy. Soc. Lond.* 2:385-386, 1938.
- ROTHSCHILD, Nathaniel Charles (1877-1923). Riley, N. D., *Proc. So. Lond. Ent. & N. H. Soc.*, 1923-24 pp. 75-76, 1924; Hoffmann, A., *Ent. Anzeiger* 3:137-139, 1923.
- ROUAST, Georges (-1898). Bouvier, E. L., *Bull. Soc. Ent. France* p. 152, 1899.
- ROUGET, Auguste (-1886). Bourgeois, J., *Ann. Soc. Ent. France* (6) 6 (Bull.): lxxxix, 1886.
- ROUGEMENT, Philippe Albert de (1850-1881). Tribolet, M. de, *B.*, *Mitt. Schweiz. Ent. Ges.* 6:259-261, 1882.
- ROUX, Emile (1853-1933). *A.*, *Bull. Inst. Pasteur* 31:1057-1059, 1933; *A.*, *Archives Inst. Pasteur Algerie* 11:523-524, 1933; Sergeant, E., *l. c.* 21:293-294, 1943.
- ROXBURGH, William (1757-1815). Rose, H. J., *New Gen. Biog. Dict.* 11:397, 1850.
- ROZIER, Francis (1734-1793). Rose, H. J., *New Gen. Biog. Dict.* 11:398, 1850.
- RUDBECK, Olaus (1660-1740). Rose, H. J., *New Gen. Biog. Dict.* 11:400-401, 1850.
- RUDOLF, Karl (1881-1937). "W.," *Ent. Zeitschr.* 51:54, 1937.
- RUDOLPH, Hugo (-1938). Nordman, A., *P.*, *Notulae Ent.* 18:69-70, 1938.
- RUDOLPH, Carl Asmund (1771-1832). Müller, J., *Edinb. New Philos. Journ.* 25:221-242, 1838; Müller, J., *B.*, *Abh. Königl. Akad. Wiss. Berlin* pp. xvii-xxxviii, 1835 (1837); Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 446-448, 1874; Lühne, M., *B.*, *P.*, *Arch. de Parasitol.* 3:549-577, 1900; Nuttall, G. H. F., *P.*, *Parasitology* 13:402-403, 1921; Brockhaus, F. A., *Der Grosse Brockhaus* 16:182, 1933.
- RÜBSAAMEN, Ewald Heinrich (1857-1919). Schaffnit, E. B., *Ztschr. Angew. Ent.* 13:210-217, 1927.
- RÜHL, Fritz (1836-1893). *A.*, *P.*, *Insekten-Börse* 10:129, 1893.
- RÜHL, Marie (1868-1930). Fischer, E., *Societas Ent.* 45:29, 1930.
- RUGGLES, Arthur Gordon (1875-1947). *A.*, *P.*, *Journ. Econ. Ent.* 41:841-842, 1948; *A.*, *Univ. Minn. Dept. Agr. Newsletter* 24:unpaged, 1947.
- RUHMANN, Max Hermann (1880-1943). Venable, E. P., *P.*, *Proc. Ent. Soc. Br. Columbia* 41:35-36, 1944.
- RUIZ PEREIRA, Hermano Flaminio (1883-1942). *A.*, *Bol. San. Veg. (Chile)* 2:144-145, 1942; Lizer y Trelles, C. A., *Curso de Entomologia* 1:27, 1947; Porter, C. E., *Rev. Chilena Hist. Nat.* 45:201, 1941 (1943).
- RUMPH (RUMPHIUS, RUMPF), Georg Eberhard (1627-1702). Rose, H. J., *New Gen. Biog. Dict.* 11:404-405, 1850.
- RUMSEY, William Earl (1865-1938). Osborn, H., *Fragments Ent. Hist.* 2:108, 1946.
- RUNNER, George A. (1876-1941). Osborn, H., *Fragments Ent. Hist.* 2:108, 1946.
- RUSCHENBERGER, William Samuel Waithman (1807-1895). Nolan, E. J., *Proc. Acad. Nat. Sci. Phila.* pp. 452-462, 1895.
- RUSCHKE, Franz (1882-1942). Fahringer, J., *B.*, *P.*, *Ztschr. Angew. Ent.* 30:151-152, 1943; Hellén, W., *Notulae Ent.* 23:60, 1943.
- RUSS, Percy (-). Beirne, B. P., *B.*, *Irish Nat. Journ.* 8:208-210, 1944.
- RUSSELL, James Anthony Peregrine (-1942). *A.*, *Entomologist* 75:72, 1942.
- RUTHE, Johann Friedrich (1788-1859). Kraatz, G., *P.*, *Berliner Ent. Ztschr.* 4:101-102, 1860.
- RUTTY, John (1698-1775). Rose, H. J., *New Gen. Biog. Dict.* 11:412, 1850.
- RUYSCH, Friedrich (1638-1731). Rose, H. J., *New Gen. Biog. Dict.* 11:412, 1850.
- RYBINSKI, Michael (1846-1905). *A.*, *Insekten-Börse* 22: 62, 1905.
- RYE, Edward Caldwell (1832-1885). *A.*, *Athenaeum*, Jan.-June:218, 1885.
- RYGGE, Johan (1868-1944). Schöyen, T. H., *P.*, *Norsk Ent. Tidsskrift* 7:136-137, 1945.
- SAALMÜLLER, Max (1832-1890). von Heyden, L., *B.*, *Ber. Senckenb. Ges.* pp. lxxxiv-xc, 1891; von Heyden, L., *B.*, *Iris* 5:453-459, 1892.
- SABINE, Ebenezer (-1906). *Insekten-Börse* 23:82, 1906; *A.*, *Entomologist* 39:120, 1906.
- SACHSE, Rudolf (-1891). Kraatz, G., *Deutsche Ent. Ztschr.* 35:11, 1891.

- SAFRO, Victor Irving (1888-1944). Leonard, M. D., *P.*, Journ. Econ. Ent. 38:727-729, 1945.
- SAGARRA Y CASTELLARNAU, Ignacio de (-). *A.*, Ciencia (Mex.) 1:121, 1940; Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:181, 1919.
- SAHAGUN, Bernardino de (-1590). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:79, 1919.
- SAHLBERG, John Reinhold (1846-1920). Saalas, U., *P.*, Ent. Blätter 16:195-199, 1920.
- SAILER, Max (-1909). Ebner, F., Ent. Zeitschrift 23:136-137, 1909.
- SAINT CYR, Dominique Napoleon (1826-1899). *A.*, *P.*, Nat. Canadien 26:45-47, 59-63, 1899.
- SALVINI, Osbert (1835-1898). "N.", Nature 58:129, 1898; *A.*, Zoologist 56:315-316, 1898.
- SAMOGGIA, Arrigo (1904-1939). Grandi, G., *B.*, *P.*, Boll. Inst. Ent. Univ. Bologna 11:64-66, 1939.
- SAMOUELLE, George (-1846). *A.*, Proc. Linn. Soc. Lond. 1:304-305, 1846.
- SANBORN, Charles Emerson (1877-1944). *A.*, Ent. News 55:215, 1944; Stiles, G. W., Science 100:140-141, 1944; *A.*, Journ. Econ. Ent. 37:569, 1944; Fenton, F. A., *P.*, *l. c.* 37:857-858, 1944; Osborn, H., Fragments Ent. Hist. 2:109, 1946.
- SANDAHL, Oskar Theodor (1829-1894). Lampa, S., *B.*, *P.*, Ent. Tidskrift 15:315-323, 1894.
- SANDBERG, Georg (1842-1891). Natvig, L. R., *B.*, *P.*, Norsk Ent. Tidsskrift 7:43-44, 1944; Schöyen, W. M., *B.*, *P.*, Ent. Tidskrift 12:71-76, 1891.
- SANDERSON, Ezra Dwight (1878-1944). Phillips, E. F., *P.*, Journ. Econ. Ent. 37:858-859, 1944.
- SANDHOUSE, Grace Adelbert (1896-1940). Osborn, H., *P.*, Fragments Ent. Hist. 2:109, 1946.
- SANG, John (1828-1887). Ellis, H. W., Proc. R. Ent. Soc. Lond. (A) 17:62-63, 1942.
- SANTSCHI, Felix (1872-1940). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 8:76-77, 1941.
- SARTORIUS, Eduard (1863-1929). Hockemeyer, E., Verh. Ver. Naturw. Heimatforsch. (Hamburg) 21:xxi-xxiii, 1929.
- SATTLER, Wilhelm (1859-1920). Bücking, H., *P.*, Ent. Blätter 16:94-96, 1920.
- SAUNDERS, Edward (1848-1910). Alfken, J. D., Deutsche Ent. Ztschr. pp. 330-331, 1910; *A.*, Ent. Record 22:75-76, 1910; South, R., Entomologist 43:103, 1910; Dixey, F. A., Trans. Ent. Soc. Lond. (Proc.):lxxxvi, 1910.
- SAUNDERS, George Sharp (1842-1910). *A.*, Ent. Mo. Mag. 46:120, 1910.
- SAUSSURE, Henri Louis Frédéric (1829-1905). Bedot, M., *B.*, *P.*, Rev. Suisse Zool. 14:1-32, 1906; *A.*, *P.*, Insekten-Börse 22:61, 1905; Le Royer, A., Mém. Soc. Phys. et Hist. Nat. Genève 35:136-144, 1906; Merrifield, F., Trans. Ent. Soc. Lond. (Proc.):lxxxv, 1905.
- SAUSSURE, Horace Benedict (1740-1799). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 450-451, 1874; Rose, H. J., New Gen. Biog. Dict. 11:467, 1850; *A.*, Encyclop. Britannica, 14th ed. 20:13, 1938.
- SAVI, Paolo (1798-1871). *A.*, Journ. de Zool. 1:96-97, 1872.
- SAXESEN, Friedrich Wilhelm Reisig (1792-1858). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 451-454, 1874.
- SAY, Thomas (1787-1834). Keep, J., West Amer. Sci. 2:85-86, 1886; Davis, J. J., *P.*, Proc. Indiana Acad. Sci. 41:40-49, 1932; Javve, B., Men of Sci. in Amer. pp. 130-153, 1944; Lizer y Trelles, C. A., Curso de Entomologia 1:12, 1947.
- SCALIGER, Julius Caesar (1484-1558). Rose, H. J., New Gen. Biog. Dict. 11:475-476, 1850; *A.*, *B.*, Encyclop. Britannica, 14th ed. 20:44, 1938.
- SCHAEFFER, Charles Frederic August (1860-1934). Osborn, H., Fragments Ent. Hist. 2:109-110, 1946.
- SCHAEFFER, Jacob Christian (1718-1790). Eiselst, J. N., Geschichte, Syst. und Literatur der Insectenk. p. 52, 1836; Weiss, H. B., Journ. N. Y. Ent. Soc. 46:244, 1938.
- SCHALLER, Johann Gottlob (1734-1813). Germar, E. F., Mag. der Ent. 1(2):193, 1815.
- SCHAUDIN, Fritz (1871-1906). Langeron, M., *B.*, *P.*, Archiv. de Parasitol. 11:388-408, 1907; Brauer, A., *P.*, Fauna Arctica 5(1):-iii, 1910.
- SCHAUFUSS, Camillo Festivus Christian (1862-1944). Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 11:57, 1944.

- SCHAUM, Hermann Rudolph (1819-1865). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 457-461, 1874; Marseul, S. A. de, *B.* only, *L'Abeille* 20 (Les Ent. et leurs Écrits):51-60, 1882; Pascoe, F. P., *Trans. Ent. Soc. Lond* (3) 2 (Proc.):137, 1864-66.
- SCHAUS, William (1858-1942). Osborn, H., *Fragments Ent. Hist.* 2:110-111, 1946.
- SCHELHAMMER, Gunther Christopher (1649-1716). Rose, H. J., *New Gen. Biog. Dict.* 11:481, 1850.
- SCHERDLIN, Paul (1872-1935). Schuler, L., *Miscellanea Ent.* 37:14-15, 1936.
- SCHUECHZER, Johann Jacob (1672-1733). Rose, H. J., *New Gen. Biog. Dict.* 11:482, 1850.
- SCHIFFERMÜLLER, Ignaz (1727-1809). Eisele, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 52-53, 1836.
- SCHILDE, Johannes (-1888). Möschler, H. B., *Stettiner Ent. Zeit.* 49:315-316, 1888.
- SCHILLE, Fryderyk Ernest (1850-1931). Niezabitowski, E. L., *B., P., Polskie Pismo Ent.* 10:77-88, 1931.
- SCHILLING, Heinrich (-1903). A., *Insekten-Börse* 20:195, 1903.
- SCHILSKY, Julius (1848-1912). Pape, P., *Deutsche Ent. Ztschr.* pp. 604-608, 1912; Horn, W., *P., Ent. Blätter* 5:97-102, 1909.
- SCHIMA, Karl (1862-1940). Kitt, M., *P., Ztschr. Wien. Ent.-Ver.* 26:34, 1941.
- SCHIMKEWITSCH, Wladimir Michailowitch (1858-1923). Bonnet, P., *P., Bibliographia Araneorum* p. 49, 1945.
- SCHINDLER, Emil (-1880). Stierlin, G., *Mitt. Schweiz. Ent. Ges.* 6:230-231, 1882.
- SCHINZ, Heinrich Rudolf (1777-1861). A., P., *An die Zürcherische Jugend (Neujahrsbl. Naturf. Ges. Zürich)* 65:1-18, 1863; Rudolphi, F., *P., Festschr. Naturf. Ges. Zürich* 1746-1896 pp. 81-84, 1896.
- SCHLEGEL, Hermann (1804-1884). A., P., *Notes Leyden Mus.* 6:79-80, 1884.
- SCHLICK, Rasmus William Traugott (1839-1916). Engelhart, C., et al., *P., Ent. Meddelelser* 11:320-335, 1917; Engelhart, C. l. c. 12:14, 1918.
- SCHLIEBEN, Ludwig Hermann von (1832-1903). A., *Insekten-Börse* 20:410, 1903; Daniel, K., *Münch. Koleopt. Ztschr.* 2:95, 1904; Kraatz, G., *Deutsche Ent. Ztschr.* 48:7, 1904.
- SCHLUGA, Johann Baptist (-). Eisele, J. N., *Geschichte, Syst. und Literatur der Insectenk.* p. 53, 1836.
- SCHMID, Anton (1809-1899). Hofmann, O., *Illust. Ztschr. f. Ent.* 4:207, 1899.
- SCHMIDT, Enrique (Henry) (1864-1948). Alexander, C. P., *Ent. News* 60:261-262, 1949.
- SCHMIDT, Ferdinand Joseph (-1877). Kraatz, G., *Deutsche Ent. Ztschr.* 22:224-225, 1878.
- SCHMIDT, Johann Andreas (1652-1726). Rose, H. J., *New Gen. Biog. Dict.* 11:486, 1850.
- SCHMIEDEKNECHT, Otto (1847-1936). Bergmann, A., *B., P., Internat. Ent. Ztschr.* 27:25-33, 1933.
- SCHNABEL, Bruno (1832-1916). Nagel, G., *Jahresh. Ver. Schles. Insectenk. Breslau* 10-12:25-26, 1919.
- SCHNEIDER, Hans (1907-1943). Escherich, K., *P., Ztschr. Angew. Ent.* 30:156-157, 1943.
- SCHNEIDER, Hans Jacob Sparre (1853-1918). Rygge, J., *B., P., Norsk Ent. Tidsskrift* 1:65-69, 1921.
- SCHNEIDER, Oskar (1841-1903). "A. C." *Rev. Russe d'Ent.* 3:345, 1903; A., *Insekten-Börse* 20:313-314, 1903; Heller, K. M., *Münch. Koleopt. Ztschr.* 2:94-95, 1904; Heller, K. M., *B., P., Iris* 16:236-246, 1903.
- SCHNUSE, Wilhelm (1850-1909). Horn, W., *Deutsche Ent. Ztschr.* p. 113, 1910; A., *Ent. Rundschau* 27:10, 1910.
- SCHOENHERR, Carl Johann (1772-1848). Marseul, S. A. de, *B., L'Abeille* 22 (Les Ent. et leurs Écrits):136-137, 1884.
- SCHOEVERS, Timon Cornelis (1878-1946). Van Eyndhoven, G. L., *Ent. Berichten* 12:38-39, 1946.
- SCHÖYEN, Wilhelm Maribo (Moritz) (1844-1918). Munster, T., *B., P., Norsk Ent. Tidsskrift* 1:3-7, 1920; Soot-Ryen, T., *Tronsø Mus. Arsh.* 65 (3) (Naturh. Avd. no. 31):6, 1942; Natvig, L. R., *B., P., Norsk Ent. Tidsskrift* 7:32-40, 1944.

- SCHOLTEN, Lambertius Henricus (-1948). Lempke, B. J., *Ent. Berichten* 12:313-314, 1949.
- SCHOMBURGH, Robert Hermann (1804-1864). Jardine, W., *P., Naturalist's Library* 39:17-79, 1848.
- SCHOPFER, Eduard (1858-1928). Heller, K. M., *B., Iris* 43:37-40, 1929.
- SCHOTT, Fred M. (1887-1946). Weiss, H. B., *B., Journ. N. Y. Ent. Soc.* 54:170-171, 1946.
- SCHREITER, Carlos Rodolfo (1897-1942). Descole, H. R., *B., Rev. Arg. Zoogeog.* 2:61-62, 1942; Lizer y Trelles, C. A., *Curso de Entomologia* 1:46, 1947.
- SCHRENK (SCHRENCK), Peter Leopold von (1826-1894). Heger, F., *Mitt. Anthropol. Ges. Wien* 24 (Sitzb.):11-12, 13, 1894.
- SCHRÖDER, Gustav (-1931). Krüger, L., *Stettiner Ent. Zeit.* 92:322-323, 1931.
- SCHROTTKY, Kurt (Carlos) (-1937). Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 5:295, 1938; Lizer y Trelles, C. A., *Curso de Entomologia* 1:28-29, 1947.
- SCHUBERT, Karl (1867-1911). Ross, E., *Internat. Ent. Ztschr.* 5:231, 1911; *A., Coleopt. Rundschau* 1:17-18, 1912.
- SCHÜBLER, Gustav (1787-1834). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 466, 1874.
- SCHÜRHOFF, Paul Norbert (-1939). *A., Ent. Blätter* 35:128, 1939.
- SCHÜTZE, Karl Traugott (1858-1938). Starke, H., *P., Iris* 52:184-185, 1938.
- SCHUKARD, William Edward (1803-1868). Newman, E., *Entomologist* 4:180-182, 1868.
- SCHULTHESS RECHBERG, Johann Anton von (1855-1941). De Beaux, O., *Ann. Mus. Civ. Stor. Nat. Genova* 61:(5)-(6), 1943; Schneider-Orelli, et al., *B., P., Verh. Schweiz. Naturf. Ges.* 122:311-318, 1942.
- SCHULTZ, Oscar Otto Karl Hugo (1868-1911). Richter, V. K. J., *P., Internat. Ent. Ztschr.* 5:183-184, 1911.
- SCHULZ, Hans (1909-1942). Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 9:127, 1942.
- SCHULZE, Carl Max Willy (1881-1940). *A., Ent. Blätter* 37:96, 1941; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 8:286, 1941.
- SCHUSTER, Adrian (1860-1942). *A., Ent. Blätter* 38:127, 1942; Natvig, L. R., *Norsk Ent. Tidsskrift* 6:228, 1942; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 9:133, 1942; Heikertinger, F., *Koleopt. Rundschau* 28:21, 1942.
- SCHWARZ, Eugene Amandus (1848-1928). *A., Anz. f. Schädlingk.* 5:16, 1929.
- SCHWARZ, Karl (1847-1898). Gerhardt, J., *Ztschr. Ent. Breslau* 23:41-42, 1898.
- SCHWARZ, Otto Carl Ernst (1861-1908). *A., Ent. Rundschau* 26:10, 1908.
- SCHWEDER, Gotthard (1832-1915). Kupffer, K. R., *B., P., Korrespondenzbl. Naturf. Ver. Riga* 57:i-xviii, 1915; Meder, A., *l. c.* 58:9-12, 1924.
- SCOPOLI, Giovanni Antonio (1723-1788). Rose, H. J., *New Gen. Biog. Dict.* 11:495, 1850; Eiselst, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 50-51, 1836; Ambrosi, F., *Bull. Soc. Veneto-Trent. Sci. Nat. (Padova)* 4:141-145, 1889; *A., Solenne commemor. di Giovanni Antonio Scopoli, (Trento)* 59 pp., 1888; de Cobelli, G., et al., *B., Lettere inedite di C. Linneo a Giovanni Antonio Scopoli, pub. xv, Mus. Civ. di Rovereto* 26 pp., 1889; Cobelli, G. de, *B., Alcune lettere inedite dirette a Giovanni Antonio Scopoli, pub. xxvii, l. c.* 47 pp., 1895; Bonnet, P., *Bibliographia Araneorum* p. 29, 1945.
- SCOTT, Louis M. (1886-1944). Sasser, E. R., *Journ. Econ. Ent.* 38:414, 1945.
- SCRIBA, Fritz (1885-1927). Seitz, A., *Ent. Rundschau* 45:5, 1928.
- SCUDDER, Samuel Hubbard (1837-1911). Cockerell, T. D. A., *P., Bios* 13:147-151, 1942; Jacobson, G. G., *Rev. Russe d'Ent.* 11:408, 1911; Remington, C. L., *Lepidopterists' News* 1:17-18, 1947; *P., only, l. c.* 2:54, 1948.
- SEBA, Albert (1665-1736). Rose, H. J., *New Gen. Biog. Dict.* 11:502-503, 1850.
- SEEBOLD, Teodoro (-1915). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:180, 1919.
- SEIDELIN, Harald (1878-1932). *A., Trans. R. Soc. Trop. Med. & Hyg.* 26:97-98, 1932.
- SEILER, Jakob, (1847-1923). Leuthardt, F., *B., P., Tätigkeitsb. Naturf. Ges. Baselland* 7:158-162, 1922-25.

- SEITNER, Moritz (1862-1936). Schimitschek, E., P., Anz. f. Schädlingk. 12:134-136, 1936; Schimitschek, E., Ztschr. f. Angew. Ent. 23:653-656, 1937.
- SEITZ, Adalbert (1860-1938). A., P., Ber. Senckenb. Naturf. Ges. 60:192, 1930; Schultz, V., P., Internat. Ent. Ztschr. 23:497-500, 1930; Meyer, W., Stettiner Ent. Zeit. 91:137-138, 1930; Kleinschmidt, O., et al., P., biog. distributed with Seitz's Grossschmetterlinge der Erde, Faunica Palaearct. 1. Hauptteil, suppl. Bd. 1, Lief. 7, 11 pp., 1930; Frickhinger, H. W., P., Ztschr. Angew. Ent. 25:535, 1938; Natvig, L. R., Norsk Ent. Tidsskrift 5:91, 1938; Hoffmann, A., P., Ent. Anzeiger 15:53-55, 1935; Reisser, H., Ztschr. Österr. Ent. Ver. 23:38-39, 1938; Franz, E., P., Natur. u. Volk (Senckenb. Naturf. Ges.) 68:354-359, 1938; Günther, K., Iris 52:95-96, 1938; Franz, E., B. only, Senckenbergiana 20:279-286, 1938; Noack, H., Ent. Rundschau 56:92-95, 1938; Hess, O., Ent. Zeitschrift 59:17-21, 1949.
- SELYS LONGCHAMPS, Michel Edmond de (1813-1900). A., P., Insekten-Börse 18:81, 1901; Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:172-173, 1919.
- SELZER, August (1850-1921). Hasebroek, K., P., Sitzb. & Vorträge Ent. Ver. Hamburg, Altona pp. 1-6, 1921-23; Hasebroek, K., P., Internat. Ent. Ztschr. 15:49-53, 1921.
- SEMENOV-TIAN-SHANSKIJ, Andrei Petrovich (1866-1942). Spacek, C., P., Folia Zool. Hydrobiol. 9:115-138, 1936; Spacek, K., Konowia 15:1-31, 1936; Spacek, K., Acta Soc. Ent. Cechoslov. 33:97-100, 1936; Uvarov, B. P., Nature 157:98, 1946; Ognev, S. I., Bull. Soc. Nat. Moscou, n. s. 51 (3), sect. biol.:122-127, 1946.
- SEMENOV-TIAN-SHANSKIJ, Peter Petrovich (1827-1914). Burr, M., Ent. Record 26:127-128, 1914; Burr, M., Ent. Mo. Mag. 50:122, 1914.
- SERGEANT, André (1903-1937). A., B., P., Arch. Inst. Pasteur Algerie 15:433-437, 1937.
- SERGEANT, Etienne (1878-1948). A., B., P., Arch. Inst. Pasteur Algerie 26:209-241, 1948.
- SERRES, Olivier de (1539-1619). Rose, H. J., New Gen. Biog. Dict. 12:3-4, 1850.
- SERVICE, Robert (1854-1911). "C. T. R.," Zoologist 69:239-240, 1911; Gladstone, H. S., Ann. Scott. N. H. pp. 129-132, 1911.
- SEVERIN, Guillaume (1862-1938). Calvert, P. P., Ent. News 50:58-60, 1939; Osborn, H., Fragments Ent. Hist. 2:111, 1946.
- SEVERINUS, Marcus Aurelius (1580-1656). Rose, H. J., New Gen. Biog. Dict. 12:8, 1850.
- SEVILLA, Isidoro de (-674). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:76, 1919.
- SHANNON, Raymond Corbett (1894-1945). Cortés, R., Agr. Técnica 5:102, 1945; A., Bull. Bklyn. Ent. Soc. 40:71, 1945; Del Ponte, E., Rev. Soc. Ent. Arg. 13:345-347, 1947.
- SHANNON, W. P. (1847-1897). Davis, J. J., P., Proc. Indiana Acad. Sci. 41:54-55, 1931.
- SHARP, David (1840-1922). "R. C. L. P.," Proc. R. Soc. Lond. (B) 95:xxxvi-xlii, 1923-24; Hudson, G. V., Trans. & Proc. N. Z. Inst. 54:xiv-xv, 1923.
- SHAW, George (1751-1813). Rose, H. J., New Gen. Biog. Dict. 12:19-20, 1850.
- SHAW, Thomas (1692-1751). Rose, H. J., New Gen. Biog. Dict. 12:19, 1850.
- SHEARWOOD, George Perry (-1891). Adkin, R., Entomologist 24:199-200, 1891.
- SHELDON, William George (1859-1943). Rait-Smith, W., Ent. Mo. Mag. 80:43-44, 1944; Turner, H. J., Ent. Record 56:128, 1944.
- SHELFORD, Robert Walter Campbell (1872-1912). Burr, M., Entomologist 45:236, 1912; Poulton, E. B., Zoologist 70:273-275, 1912.
- SHERBORN, Charles Davies (1861-1942). Chapman, F., P., Victorian Nat. 60:76-77, 1943; Woodward, A. S., Quart. Journ. Geol. Soc. Lond. 98:1xxx1-1xxxii, 1943; Woodward, A. S., Proc. Linn. Soc. Lond. 154:295-296, 1941-42.
- SHERMAN, Franklin (1877-1947). Bentley, G. M., P., Journ. Econ. Ent. 40:610-611, 1947.
- SHESTAKOV, Andre Valentinovich (1890-1933). Gussakovskij, V. V., B., P., Rev. Ent. U. R. S. S. 25:324-328, 1935.
- SHIBUYA, J. (-). Remington, C. L., Ann. Ent. Soc. Amer. 39:449, 1946.
- SHIPLEY, Arthur Everett (1861-1927). "S. F. H.," P., Proc. R. Soc. Lond. (B) 103:i-

- viii, 1928; Howard, L. O., P., Pop. Sci. Mo. 87:69, 1915.
- SHIPP, John William (-1898). A., Insekten-Börse 15:85, 1898; A., Entomologist 31:100, 1898.
- SHOCH, Gustav (1833-1899). A., B., P., Insekten-Börse 16:61, 1899.
- SHUBERT, Karl (-1911). A., Coleopt. Rundschau 1:17-18, 1911.
- SHUGUROO, Alexander Mikailovich (1881-1912). Burr, M., Ent. Record 24:278-279, 1912.
- SICH, Alfred (-1943). Turner, H. J., Ent. Record 55:70, 1943.
- SICHEL, Jules (1802-1868). Mulsant, E., B., P., Opuscles Ent. 14:73-102, 1869.
- SICHIROLLO, Giuseppe (-). A., Boll. Soc. Ent. Ital. 67:49, 1935.
- SIDEBOTHAM, Joseph (1824-1885). McLachlan, R., Trans. Ent. Soc. Lond. (Proc.):xlii, 1885; A., Ent. Mo. Mag. 22:46, 1885.
- SIEBKE, Johan Heinrich Spalckhauer (1816-1875). Schneider, J. S., B., Enumeratio Insectorum Norvegicorum 3:vii-x, 1876; Natvig, L. R., P., Norsk Ent. Tidsskrift 7:23-25, 1944; Soot-Ryen, T., Tromsø Mus. Arsh. 65 (3) (Naturh. Avd. no. 31):5-6, 1942.
- SIEBOLD, Johan Heinrich Spalckhauer (1816-1875). Schneider, J. S., B., Enumeratio Insectorum Norvegicorum 3:vii-x, 1876; Natvig, L. R., P., Norsk Ent. Tidsskrift 7:23-25, 1944; Soot-Ryen, T., Tromsø Mus. Arsh. 65 (3) (Naturh. Avd. no. 31):5-6, 1942.
- SIEBOLD, Carl Theodor Ernst von (1804-1885). McLachlan, R., Trans. Ent. Soc. Lond. (Proc.):xl-xli, 1885; A., Athenaeum no. 2999:507, 1885.
- SIEVERS, Johann Christoph (1805-1867). Hagen, H. A., B., Bibliotheca Ent. 2:163-164, 1863; Horn & Schenkling, B., Index Litt. Ent. 4:1131-1132, 1928.
- SIEWERS, Charles Godfrey (1815-1882). A., Psyche 3:359-360, 1882.
- SIKORA, Franz (-1902). A., Insekten-Börse 22:33, 1905; Daniel, K., Münch. Koleopt. Ztschr. 1:261-262, 1903.
- SILBERNAGEL, A. (1892-1944). Paclt, J., B., P., Acta Soc. Ent. Cechosl. 42:145-147, 1945.
- SILLIMAN, Benjamin (1816-1885). A., Athenaeum no. 2987:124-125, 1885.
- SILVERLOCK, Oscar C. (-1911). Morice, F. D., Trans. Ent. Soc. Lond. (Proc.):cxi-cxii, 1911.
- SILVESTRI, Filippo (1873-1949). A., Ent. News 60:154, 1949; Thompson, W. R., Can. Ent. 81:215-216, 1949; List of publications to Feb., 1930, Portici, 1930; Porter, C. E., P., Rev. Chilena Hist. Nat. 39:225-227, 1935; Grandi, G., P., Boll. Inst. Ent. Bologna 15:v, 1944-46.
- SIMMONS, Samuel (1856-1939). A., P., British Bee Journ. 68(3011):105, 1945.
- SIMON, Eugène (1848-1924). Bonnet, P., P., Bibliographia Araneorum pp. 40-41, 1945.
- SINTENIS, Franz 1836-1911). Strand, E., B., Folia Zool. et Hydrobiol. 11:46-53, 1941; Djakonov, A., B., Rev. Russe Ent. 11:310-313, 1911.
- SITOWSKI, Ludwik (1880-1947). Linke, A., B., Polskie Pismo Ent. 18:5-13, 1939-48.
- SJÖSTEDT, Julius Erik (1902-1944). Kivirikko, E., Ann. Soc. Ent. Fennici 10:151-152, 1944.
- SJÖSTEDT, Yngve (1866-1948). A., P., Ent. Tidsskrift 69(3):frontispiece, 1948; Pasteels, J., Bull. & Ann. Soc. Ent. Belg. 84:221, 1948.
- SKINNER, Henry (1861-1926). Remington, J. E., Lepidopterists' News 1:69, 1947.
- SLADDEN, Dorothy (-1937). MacBride, E. W., Nature 140:184, 1937.
- SLADEN, Frederick William Lambert (1876-1921). Gibson, A., Can. Ent. 53:240, 1922.
- SLASTSCHEWSKY, P. (-1935). A., Arb. Morph. Taxon. Ent. Berlin-Dahlem 2:63, 1935.
- SLEVOGT, Johann Benedikt Balduin (1847-1911). A., P., Deutsche Ent. Nat.-Bibliothek 2:31-32, 1911; Kuznezov, N. J., B., Rev. Russe Ent. 11:162-165, 1911; Strand, E., B., Folia Zool. et Hydrobiol. 11:110-111, 1941.
- SLINGERLAND, Mark Vernon (1864-1909). Horn, W., Deutsche Ent. Ztschr. p. 583, 1909; A., Ent. Rundschau 26:81, 1909.
- SLOANE, Hans (1660-1753). Rose, H. J., New Gen. Biog. Dict. 12:49-50, 1850.
- SMART, Herbert Douglas (1880-1945). "H. B. W.," et al., Entomologist 78:192, 1945.
- SMEATHMAN, Henry (1750-1787). Griffin, F. J., Proc. R. Ent. Soc. Lond. (A) 17:1-9, 1942.
- SMELLIE, William (1740-1795). Rose, H. J., New Gen. Biog. Dict. 12: 52, 1850.

- SMETHURST, Charles (-1892). Nelson, W., P., *Naturalist* (Lond.) pp. 145-146, 1892.
- SMITH, Adam Charles (1871-1943). "J. A. S.," et al., *London Nat.* 1943, pp. 48-49, 1944.
- SMITH, Barnard (-1903). A., *Ent. Mo. Mag.* 39:304, 1903.
- SMITH, Clive Bramwell (-1945). "J. A. S.," *London Nat.* 25:77-78, 1945.
- SMITH, Frederick (1805-1879). Dunning, J. W., P., *Entomologist* 12:88-92, 1879; A., *Ent. Mo. Mag.* 15:263-264, 1879; "W. D. R.," *Naturalist* (Yorkshire) 4:138, 1879.
- SMITH, John Bernhardt (1858-1912). Howard, L. O., *Science*, n. s. 35:613-614, 1912; Remington, J. E., *Lepidopterists' News* 1:81, 1947.
- SMITH, Ralph Henry (1888-1945). Essig, E. O., P., *Journ. Econ. Ent.* 38:624-625, 1945; A., *Ent. News* 56:280, 1945; Essig, E. O., *Ann. Ent. Soc. Amer.* 39:5-6, 1946; A., P., *Bull. So. Calif. Acad. Sci.* 44:138-139, 1945.
- SMITH, Theobald (1859-1934). A., *Journ. Parasitol.* 21:51, 1935; Hall, M. C., P., *l. c.* 21:231-243, 1935.
- SMOLKA, Alois (-1928). A., *Ent. Nachrichtenbl.* 2:76, 1928.
- SMYTH, Ellison Adger, Jr. (1863-1941). Osborn, H., P., *Fragments Ent. Hist.* 2:111-112, 1946.
- SNELLEN, Pieter Cornelius Tobias (1832-1911). Lambillion, L. J., *Rev. Mens. Soc. Ent. Namuroise* 11:34-35, 1911.
- SNOW, Francis Huntington (1840-1908). A., *Ent. Rundschau* 26:3, 1909.
- SNOW, William Appleton (1869-1899). A., B., *Kansas Univ. Quart.* 8:189, 1899.
- SOBOLEV, Aleksii Nikolaevich (1870-1911). Silantjev, A., *Rev. Russe Ent.* 11:461-462, 1911.
- SÖDERMAN, Aleksander Henrik (1876-1933). Palmgren, A., P., *Mem. Soc. Fauna et Flora Fenn.* 10:448-449, 461-462, 1934.
- SÖRENSEN, William Emil (1848-1916). Bonnet, P., P., *Bibliographia Araneorum* pp. 43-44, 1945.
- SÖYRINKI, Yrjö Johannes (1904-1941). Kangas, E., *Ann. Ent. Fennici* 10:152, 156, 1944.
- SOKOLÁR, Franz (1851-1913). A., B., *Ent. Zeitschrift* 27:163-164, 1913; "J. Z.," B., *Coleopt. Rundschau* 2:148-153, 1913.
- SOLIER, Antoine Joseph Jean (1792-1851). Marseul, S. A. de, B. only, *L'Abeille* 20 (Les Ent. et leurs Ecrits): 39-42, 1882.
- SOMERSALO, Arne Sakari (1891-1941). Saalas, U., *Ann. Ent. Fennici* 10:153-154, 1944.
- SOMMER, C. F. (1857-1899). Dittrich, R., B., *Ztschr. f. Ent.* (Breslau) 25:25-26, 1910.
- SORHAGEN, Ludwig Friedrich (1836-1914). Brunn, M. von, *Internat. Ent. Ztschr.* 13:5-6, 1919.
- SOUDEK, Stěpán (1889-1936). Kratochvil, J., B., P., *Acta Soc. Ent. Cechosl.* 33:125-131, 1936; Storkán, J., P., *Acta Soc. Zool. Cechosl.* 4:117-118, 1936.
- SOUTH, Richard (1846-1932). A., *Nature* 129:605, 1932.
- SPÄTH, Franz (1863-1946). Schedl, K. E., *Zentralbl. Gesamtgeb. Ent.* 1:95, 1946; A., *Coleopt. Rundschau* 19:244, 1933.
- SPALDING, Thomas Utting (1866-1929). Osborn, H., *Fragments Ent. Hist.* 2:112, 1946.
- SPALLANZANI, Lazzaro (1729-1799). Rose, H. J., *New Gen. Biog. Dict.* 12:80-81, 1850; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 471-474, 1874; A., B., P., *Parasitology* 14:409-412, 1922.
- SPANGBERG, Jacob (1846-1894). A., *Ent. Mo. Mag.* 30:137, 1894.
- SPARRMANN, Anders (1748-1820). Rose, H. J., *New Gen. Biog. Dict.* 12:83, 1850.
- SPEMANN, Hans (1869-1941). Sachtleben, H., *Arb. Physiol. Angew. Ent.* Berlin-Dahlem 9:55, 1942.
- SPENCE, Robert Henry (-1851). Westwood, J. O., *Trans. Ent. Soc. Lond.* (2) 1 (Proc.):135, 1851.
- SPENCE, William (1783-1860). Schaum, H. R., *Berliner Ent. Ztschr.* 4:103-104, 1860; Griffin, F. J., *Naturalist* (Lond.) p. 178, 1933; Eiselt, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 101-105, 1836.
- SPENCE, William Blundell (-1900). A., *Ent. Mo. Mag.* 36:66, 1900; Verrall, G. H., *Trans. Ent. Soc. Lond.* (Proc.):xlii-xliii, 1900.

- SPERONI, Alberto P. (1893-1944). *A., P., Rev. Soc. Ent. Arg.* 12:339, 1945.
- SPESSIVTSEFF Paul (1866-1938). Butovitsch, V. von, *B., P., Ztschr. Angew. Ent.* 25:536-537, 1938.
- SPEYER, Adolph (1812-1892). Elwes, H. J., *Trans. Ent. Soc. Lond. (Proc.)*:lvii-lviii, 1893.
- SPINOLA, Maximilian (1780-1857). Saunders, W. W., *Trans. Ent. Soc. Lond. (Proc.)*:102, 1856-58.
- SPORMAN, Karl (1863-1937). Pfau, J., *P., Ent. Zeitschrift* 52:73-75, 1938.
- SPRING, Frederic Antoine Joseph (1814-1872). Dewalque, G., *Bull. Acad. Roy. Belg. (2)* 33:94-102, 1872.
- SPURNY, Johann (1865-1940). Heikertinger, F., *Koleopt. Rundschau* 26:92, 1940.
- STÄDLER, Fritz (-1919). *A., Internat. Ent. Ztschr.* 13:82, 1919.
- STAEGER, Rasmus Carl (1800-1875). Spärck, R., *P., Vidensk. Medd. Dansk Naturh. For. Kopenh.* 95:50-51, 1933.
- STAINFORTH, Thomas (-1944). Walsh, G. B., *Ent. Mo. Mag.* 80:86, 1944.
- STAL, Carl (1833-1878). Distant, W. L., *Ent. Mo. Mag.* 15:191-192, 1879.
- STALEY, Oliver Jacob (1869-1894). Kunze, R. E., *Can. Ent.* 27:133, 1895.
- STAMM, Robert Hutzen Pedersen (1877-1934). Henriksen, K., *B., Ent. Meddelelser* 15:507-508, 1933.
- STANDFUSS, Gustav (1815-1897). Schaufuss, C., *P., Insekten-Börse* 14:247, 1897.
- STANDFUSS, Maximilian Rudolf (1854-1917). *A., Ent. Zeitschrift* 30:93-94, 1917; Ris, F., *B., Ver. Schweiz. Naturf. Ges.* 100:136-142, 1918; Schellenberg, F. C., et al., *P., Mitt. Ent. Zürich* 3:154-196, 1917; Heller, K. M., *B., Iris* 31:60-65, 1917; Ris, F., *P., Rectoratsreden & Jahresh. Univ. Zürich* pp. 55-57, 1916-17; Ris, F., *Vierteljahrschr. Naturf. Ges. Zürich* 62:690-693, 1917.
- STANTON, Ambrose Thomas (1875-1938). Roubaud, E., *Bull. Soc. Path. Exot.* 31:179, 1938; *A., Trop. Agr.* 15:55, 1938; Freyer, J. C. F., *Proc. R. Ent. Soc. Lond. (C)* 3:59-60, 1938.
- STANTON, Henry Tibbats (1822-1892). Godman, F. D., *Trans. Ent. Soc. Lond. (Proc.)*:xlviii-1, 1892; *A., P., Insekten-Börse* 10:43, 1893.
- STARK, Josef (1813-1889). Dohrn, C. A., *Stettiner Ent. Zeit.* 50:320-322, 1889.
- STATHER, Thomas (1812-1878). Stainforth, T., *Trans. Hull. Sci. & Field Nat. Club* 4:281-298, 1919.
- STAUDINGER, Otto (1830-1900). Meissner, O., *P., Ent. Zeitschrift* 42:225-227, 1928; Grote, A. R., *Can. Ent.* 32:368, 1900; *A., P., Insekten-Börse* 17:337, 1900; *A., Ent. Record* 12:352-453, 1900.
- STAUNTON, George Leonard (1737-1801). Rose, H. J., *New Gen. Biog. Dict.* 12:105-106, 1850.
- STEDMAN, John Gabriel (1744-1797). Rose, H. J., *New Gen. Biog. Dict.* 12:106, 1850.
- STEENBERG, Carl Marinus (1882-1946). Tuxen, S. L., *B., P., Ent. Meddelelser* 25:142-144, 1947; Degerböl, M., *P., Vidensk. Meddelelser* 109:v-x, 1945-46.
- STEENSTRUP, Johann Japetus (1813-1897). Spärck, R., *P., Vidensk. Medd. Dansk Naturh. For. Kopenh.* 95:56-90, 1933.
- STEFANELLI, Pietro (-). Verity, R., *Bull. Soc. Ent. Ital.* 51:76-81, 1919.
- STEIN, F. (-). Davis, J. J., *Proc. Indiana Acad. Sci.* 41:55, 1931.
- STEINERT, Hermann (-1898). Schloffer, E., *B., Iris* 11:400-401, 1898.
- STERMIDING, Steven (-1949). MacGillavry, D., *Ent. Berichten* 12:393, 1949.
- STENBERG, Isaac Ludwig (-1891). Sandahl, O. T., *Ent. Tidskrift* 12:16, 1891.
- STEP, Edward (1855-1931). Fortune, R., *Naturalist (Lond.)* pp. 15-16, 1932.
- STEPÁN, Václav J. (1873-1941). Šamál, J., *Acta Soc. Ent. Bohemiae* 38:1-2, 1941.
- STEPHENS, James Alfred (-1947). Blair, K. G., *Ent. Mo. Mag.* 83:135, 1947.
- STEPHENS, James Francis (1792-1852). *A., Proc. Linn. Soc. Lond.* 2:239-240, 1853; Stainton, H. T., *Bibliotheca Stephensiana* pp. (2)-(10), 1853.
- STEPHENSEN, Knuth (1882-1947). Tuxen, S. L., *P., Ent. Meddelelser* 25:196-199, 1947.
- STERNE, Carus (pseudonym of Ernst Krause) (-1903). *A., Insekten-Börse* 20:306, 1903.
- STERNECK, Jakob Daublebsky von (1868-1941). Reisser, H., *B., P., Ztschr.* *Wien Ent. Ver.* 26:265-271, 1941; Obenberger, J., *B., P., Acta Soc. Ent. Bohemiae* 38:28-33, 1941; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 8:77, 1941.

- STERTZ, Otto (1847-1918). Möbius, E., *B.*, *Iris* 32:134, 1918; Wolf, P., *B.*, *Jahresh. Ver. Schles. Insektenk.* Breslau 10-12, 23-25, 1919.
- STEUDEL, Wilhelm (1829-1903). *A.*, *Insekten-Börse* 20:403, 1903; Klunzinger, C. B., *B.*, *Jahresh. Ver. Vaterl. Naturk. Württemb.* 60:xxxv-xliii, 1904.
- STEVENS, John Sanders (-1903). *A.*, *Ent. Mo. Mag.* 39:229, 1903.
- STEVENS, Samuel (1817-1899). *A.*, *Entomologist* 32:264, 1899; *A.*, *Ent. Record* 11:308, 1899.
- STEWART, A. M. (-1948). Williams, C. B., *Proc. R. Ent. Soc. Lond. (C)* 13:68, 1948-49.
- STIEBER, Ernst (1829-1906). "A. Gr.," *P.*, *Insekten-Börse* 23:145, 1906.
- STIERLIN, Wilhelm Gustav (1821-1907). Krancher, O., *P.*, *Ent. Jahrbuch* 17:202, 1908.
- STILES, Charles Wardell (1867-1941). Cram, E. B., *P.*, *Rev. de Med. Trop. y Parasit. Bact., Clin. y Lab. (Cuba)* 7:1-2, 1941; Wright, W. H., *Journ. Parasitol* 27:195-201, 1941; Osborn, H., *Fragments Ent. Hist.* 2:113-114, 1946.
- STILL, John Nathaniel (-1895). *A.*, *Ent. Mo. Mag.* 31:270-271, 1895; South, R., *Entomologist* 28:315, 1895.
- STITT, Edward Rhodes (1867-1948). Bishopp, F. C., *Journ. Wash. Acad. Sci.* 39:381-382, 1949.
- STONER, Dayton (1883-1944). Snyder, L. L., *P.*, *Journ. Mammalogy* 26:111-113, 1945 (*Bibliog. of mammals*).
- STORKÁN, Jaroslav (1890-1942). Komárek, J., *B.*, *P.*, *Acta Soc. Zool. Cechosl.* 10:24-26, 1945-46.
- STORM, Vilhelm Ferdinand Johan (1835-1913). Soot-Ryen, T., *Tromsø Mus. Arsh.* 65 (3) (*Naturh. Avd. no. 31*):6, 1942.
- STRACENER, Charles Lyman (1878-1941). Osborn, H., *Fragments Ent. Hist.* 2:114-115, 1946.
- STRAUB, Anton (1859-1939). Heytovsky, L., *Acta Soc. Ent. Bohemiae* 36:75-76, 1939.
- STRAUCH, Alexander (1832-1893). *A.*, *Leopoldina* 29:162, 1893.
- STRAUSS, Leopold (-1940). Heikertinger, F., *Koleopt. Rundschau* 26:92, 1940.
- STRECKER, Ferdinand Heinrich Herman (1836-1901). Remington, J. E., *P.*, *Lepidopterists' News* 2:98, 1948.
- STRECKFUSS, Adolf (-1895). Dönitz, W., *Berliner Ent. Ztschr.* 40:373-374, 1895.
- STROBL, Gabriel (1846-1925). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:185, 1919.
- STRÖM, Hans (1726-1797). Soot-Ryen, T., *Tromsø Mus. Arsh.* 65 (3) (*Naturh. Avd. no. 31*):5, 1942.
- STROHL, Jean (1886-1942). "K.," *Mitt. Schweiz. Ent. Ges.* 18:531, 1943; Fisher, H., *P.*, *Verh. Schweiz. Naturf. Ges.* 123:320-326, 1943; Peyer, B., *B.*, *Vierteljahrsschr. Naturf. Ges. Zürich* 87:533-539, 1942; Sachtleben, H., *Arb. Physiol. Angew. Ent. Berlin-Dahlem* 10:259, 1943.
- STROMBERG, Charles W. (1856-1895). Knaus, W., *Can. Ent.* 27:300, 1895.
- STRONG, Lee Abram (1886-1941). Hecke, G., *P.*, *Bull. Calif. Dept. Agr.* 30:223, 1941; Osborn, H., *Fragments Ent. Hist.* 2:115-116, 1946.
- STUBENRAUCH, Ludwig von (1865-1940). Osthelder, L., *B.*, *P.*, *Mitt. Muench. Ent. Ges.* 31:363-364, 1941.
- STUDY, Eduard (1862-1930). Seitz, A., *Ent. Rundschau* 47:9, 1930.
- STÜBEL, Alfons (-1904). *A.*, *Insekten-Börse* 21:370, 1904.
- STURANY, Rudolf (1867-1935). Adensamer, W., *Ann. Naturh. Mus. Wien* 47:59-60, 1936.
- STURM, Jacob (1771-1848). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 475-476, 1874; Eisinger, F., *B.*, *P.*, *Internat. Ent. Ztschr.* 13:105-111, 1919.
- STUSSINER, Josef (1850-1917). Reitter, E., *Wiener Ent. Zeit.* 37:120-122, 1918.
- SUARS, Ernest (1857-1909). Poskin, J., *Rev. Mens. Soc. Ent. Namuroise* 9:81, 1909.
- SUFFRIAN, Christian Wilhelm Ludwig Eduard (1805-1876). Marseul, S. de, *B.* only, *L'Abeille* 21 (*Les Ent. et leurs Écrits*):108-109, 1883.
- SULZER, Johann Heinrich (1735-1813). Eiselt, J. N., *Geschichte, Syst. und Literatur der Insektenk.* p. 46, 1836.
- SUMMERS, John Nicholas (1884-1941). Osborn, H., *Fragments Ent. Hist.* 2:116, 1946.

- SUNDEVALL, Carl Jacob (1801-1875). Bonnet, P., *P.*, *Bibliographia Araneorum* p. 35, 1945.
- SURFACE, Harvey Adams (1867-1941). Osborn, H., *P.*, *Fragments Ent. Hist* 2:117, 1946.
- SUSHKIN, Petr Petrovich (1868-1928). Menzbir, M., et al., *B.*, *P.*, *Ann. Mus. Zool. Leningrad* 29:1-12, i-xxxi, 1928.
- SWAINSON, William (1789-1855). Bell, T., *B.*, *Proc. Linn. Soc. Lond.* 1:xliv-liv, 1857.
- SWAMMERDAM, Johann Jacob (1637-1680). Eiselt, J. N., *Geschichte, Syst. und Literatur der Insectenk.* pp. 24-26, 1836; Pellett, K. L., *P.*, *Amer. Bee Journ.* 69:130-131, 1929; Rose, H. J., *New Gen. Biog. Dict.* 12:158-159, 1850; Lizer y Trelles, C. A., *Curso de Entomologia* 1:7-8, 1947.
- SWEET, Georgina (-1946). "P. C. M.," *Victorian Nat.* 62:211-212, 1946.
- SWEET, Winfield Carey (1891-1942). A., *P.*, Rockefeller Found. Internat. Health Div. Ann. Rpt., unpagged, 1942; Cort, W. W., *P.*, *Journ. Parasitology* 29:365-366, 1943.
- SWENK, Myron Harmon (1883-1941). Osborn, H., *Fragments Ent. Hist.* 2:117, 1946.
- SWINTON, John (1703-1777). Rose, H. J., *New Gen. Biog. Dict.* 12:166-167, 1850.
- SWYNNERTON, Charles Francis Massy (1877-1938). Fryer, J. C. F., *Proc. R. Ent. Soc. Lond. (C)* 3:59, 1938.
- SZEDLACZEK, Stefan (1846-1907). Aigner, L., *P.*, *Rovartani Lapok (Budapest)* 14:161-162; German summary 14(8):11, 1907.
- TAIT, William (-1904). A., *Ann. Scott. Nat. Hist.* pp. 137-138, 1904.
- TANQUARY, Maurice Cole (1881-1944). Riley, W. A., *Science* 100:539-540, 1944; A., *Ann. Ent. Soc. Amer.* 38:143, 1945; A., *P.*, *Journ. Econ. Ent.* 38:504, 1945.
- TARGIONI-TOZZETTI, Adolfo (1823-1902). A., *Ent. Mo. Mag.* 39:20, 1903.
- TARGIONI-TOZZETTI, Giovanni (1712-1783). Rose, H. J., *New Gen. Biog. Dict.* 12:179, 272-273, 1850.
- TARNANI, Ivan Konstantinovic (1865-1930). Strawinski, K., *P.*, *Polski Pismo Ent.* 9:293-295, 1930.
- TAVARES, Joaquin da Silva (Joachim da Silva) (1866-1931). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:193-194, 1919; A., *Butl. Inst. Catalana Hist. Nat.* 31:183, 1931; Navás, L., *Atti Pontif. Accad. Sci. Nuovi Lincei (Rome)* 84:652-653, 1931; Houard, C., *P.*, *Marcellia* 27:107-119, 1932.
- TAYLOR, Frank Henry (1886-1945). Browne, I. A., *Proc. Linn. Soc. N. S. Wales* 71:ii, 1946.
- TAYLOR, George William (1851-1912). Hatch, M. H., *P.*, *Century of Ent. in Pacific Northwest* pp. 6-7, 1949.
- TAYLOR, John (-1920). A., *Ent. Record* 32:194, 1920.
- TEJERO, José Arias (1800-1867). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:82, 1919.
- TENGSTRÖM, Johan Martin Jakob von (1821-1890). Lindelöf, L. L., *Öfvers. Finsk Vetensk.-Soc. Förh.* 33:279-280, 1891; Sahlberg, J., *B.*, *P.*, *Ent. Tidskrift* 12:177-190, 1891; A., *Ent. Mo. Mag.* 27:111-112, 1891.
- TENZEL (TENZEL), Wilhelm Ernst (1659-1707). Rose, H. J., *New Gen. Biog. Dict.* 12:201-202, 1850.
- TERMAYER, Raimondo Maria de (1740(?)). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:78, 1919.
- TERRY, Frank Wray (1877-1911). A., *Ent. Mo. Mag.* 48:15, 1912.
- TERTRE, Jean Baptiste du (1610-1687). Rose, H. J., *New Gen. Biog. Dict.* 12:204, 1850.
- TERTTI, Martti (1898-1940). Saalas, U., *P.*, *Erip. Luonnon Ystävä* pp. 9-12, 1940.
- THAXTER, Rowland (1858-1932). A., *Nature* 130:84-85, 1932; Setchell, W. A., *Proc. Amer. Acad. Arts & Sci.* 68:678-682, 1933.
- THEDENIUS, Knut Frederik (1814-1894). Sandahl, O. T., *B.*, *P.*, *Ent. Tidskrift* 15:191-199, 1894.
- THEOBALD, Frederick Vincent (1868-1930). Howard, L. O., *P.*, *Pop. Sci. Monthly* 87:70, 1915; Duffield, C. A. W., *P.*, *Books, reports, pamphlets and papers by F. V. Theobald*, Wye, Kent 16 pp., 1931.
- THEOPHRASTUS, Eresius (372-288 B.C.). Rose, H. J., *New Gen. Biog. Dict.* 12:216-217, 1850; Percheron, A., *Bibliographie Ent.* 2:92, 1837.

- THÉRY, André (1864-1947). Boudy, P., B., P., Bull. Soc. Sci. Nat. Maroc 25:27; 105-107, 1945-47.
- THIELE, Hermann (1841-1918). Stichel, H., Internat. Ent. Ztschr. 13:81-82, 1919.
- THIEME, Otto (1837-1907). A., Ent. Zeitschrift 21:95-96, 1907; Krancher, O., Ent. Jahrbuch 17:200, 1908.
- THIERSCH, Ernst Ludwig (1786-1869). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 483-484, 1874.
- THIJSSE, Jac. P. (1865-1945). MacGillavry, D., Ent. Berichten 11:260-262, 1945.
- THOMAS, Friedrich August Wilhelm (1840-1918). Hedicke, H., Deutsche Ent. Ztschr. p. 233, 1919; Hubenthal, W., P., Ent. Blätter 15:87-88, 1919.
- THOMPSON, J. Ashburton (1848-1915). Taylor, F. H., P., Proc. Linn. Soc. N. S. Wales 68(1-2):viii, 1943.
- THOMPSON, Millett Taylor (1875-1907). Felt, E. P., Thompson's Illustr. Cat. Amer. Ins. Galls pp. 3-4, 1915.
- THOMPSON, William (-1892). A., Entomologist 25:328, 1892.
- THOMSON, Charles Wyville (-1882). A., Ent. Mo. Mag. 18:264, 1882.
- THOMSON, John Gordon (-1937). A., Nature 140:495, 1937.
- THOR, Sigmund (1856-1937). Lundblad, O., B., P., Ent. Tidskrift 59:107-111, 1938; Viets, K., Arch. Hydrobiol. 32:515, 1938; Natvig, L. R., B., P., Norsk Ent. Tidskrift 7:49-58, 1944.
- THORELL, Tord Tamerlan Teodor (1830-1901). Bonnet, P., P., Bibliographia Araneorum p. 39, 1945.
- THORNLEY, Alfred (1855-1947). Scott, H., Ent. Mo. Mag. 83:109-110, 1947.
- THORNTHWAITE, William Henry E. (-1908). A., Ent. Record 20:190-191, 1908; A., Entomologist 41:208, 1918.
- THORSTENSEN, T. D. (-1940). Knaben, N., Norsk Ent. Tidskrift 6:50, 1941.
- THUNBERG, Carl Peter (1743-1828). Rose, H. J., New Gen. Biog. Dict. 12:235, 1850.
- THURAU, Friedrich (1843-1913). A., Ent. Zeitschrift 26:Beilage to no. 44, 1913.
- TIEF, Wilhelm (1846-1896). Mik, J., Wiener Ent. Zeit. 15:264, 1896; Kettner, A., et al., Carinthia II 86:137-144, 1896.
- TILLYARD, Robin John (1881-1937). Lestage, J. A., Bull. & Ann. Soc. Ent. Belg. 77:259-260, 1937; Evans, J. W., P., Proc. Linn. Soc. N. S. Wales 71:252-256, 1946; Hull, A. F. B., P., Australian Zool. 8:343, 1937; Osborn, H., Fragments Ent. Hist. 2:117, 1946.
- TILTSCHER, Paul (1891-1917). Esiki, E., Rovartani Lapok 24:179-180, 196, 1917.
- TIMM, Wulf Wilhelm (1850-1924). A., B., Sitzb. & Vorträge Ent. Ver. Hamburg-Altona pp. 56-57, 1924.
- TISCHBEIN, Peter Friedrich Ludwig (1813-1883). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 484-486, 1874.
- TISCHLER, Theodor (1864-1919). Hedwig, K., Jahresh. Ver. Schles. Insektenk. Breslau 10-12, 26, 1919.
- TITZE, Albert (-1899). Wocke, F., Ztschr. f. Ent. (Breslau) 25:24-25, 1900.
- TÖLG, Franz (1877-1917). Heikertinger, F., B., Ztschr. Angew. Ent. 4:184-186, 1917.
- TONNOIR, André Léon (1885-1940). "D. M.", P., Trans. & Proc. R. Soc. N. Z. 70:xxxvii, 1940; Holmes, J. M., Proc. Linn. Soc. N. S. Wales 65:ii, 1940; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 7:336, 1940.
- TORNIER, Gustav (-1938). A., Ent. Zeitschrift 52:93, 1938.
- TORRE-BUENO, Jose Rollin de la (1871-1948). Olsen, C. E., Bull. Bklyn. Ent. Soc. 43:135-137, 1948; Sherman, J. D., P., l. c. 43:154-156, 1948; Remington, C. & J., Lepidopterists' News 2:42, 1948.
- TORRE E TASSO, Alexandro Carlo della (1881-1937). Koch, C., Ent. Zeitschrift 51:197-200, 1937.
- TOSQUINET, Pierre Jules (1824-1902). A., Insekten-Börse 21:153, 1904; Jacobs, J. C., Ann. Soc. Ent. Belg. 46:487-489, 1902.
- TOURRETTE, Marc Antoine Louis Claret de la (1729-1793). Rose, H. J., New Gen. Biog. Dict. 12:270, 1850.
- TOWNSEND, Charles Henry Tyler (1863-1944). Townsend, C. H. T., P., Rev. Ent. (Rio d. J.) 14:311-313, 1943; Borgmeier, T., et al., P., l. c. 15:236-239, 1944; Rev. Univ. (Univ. Cat. de Chile) 29(1):109-111, 1944; James, M. T., Ann. Ent. Soc. Amer. 38:143-144, 1945.

- TOZETTI, Giovanni Targioni (1712-1783). Rose, H. J., *New Gen. Biog. Dict.* 12:179, 272-273, 1850.
- TRAIL, James William Helenus (1851-1919). "D. P.," *Proc. R. Soc. Lond. (B)* 91: vii-xi, 1920; Ritchie, J. P., *Scottish Nat.* pp. 1-5, 1920.
- TRALLES, Balthasar Ludwig (1708-1797). Rose, H. J., *New Gen. Biog. Dict.* 12:274, 1850.
- TRAUTMANN, Woldemar (1880-1929). Hepp, A., *Ent. Zeitschrift* 43:267, 1930.
- TREDL, Rudolf (1871-1921). Kleine, R. P., *Ent. Blätter* 18:65, 1922.
- TREMBLEY, Abraham (1710-1784). Rose, H. J., *New Gen. Biog. Dict.* 12:276, 1850; Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 60 (footnote), 1874.
- TREMOLERAS, Juan (1870-1934). Cordero, E. H., B., *Physis (Arg.)* 11:541-544, 1935; A., B., P., *Rev. Soc. Ent. Arg.* 6:284-286, 1934; Lizer y Trelles, C. A., *Curso de Entomologia* 1:29-30, 1947.
- TRESS-BEALE, S. C. (-1885). A., *Ent. Mo. Mag.* 22:216, 1886.
- TREVIRANUS, Ludolph Christian (1779-1864). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 494-495, 1874.
- TREW, Christoph Jacob (1695-1769). Rumpel, H. E., B., *Nova Acta Acad. Leopold.-Carol. Nat. Cur.* 4 (Suppl.):315-332, 1770; Rose, H. J., *New Gen. Biog. Dict.* 12:278-279, 1850.
- TRIEWALD, Mårten (1691-1747). Rose, H. J., *New Gen. Biog. Dict.* 12:279, 1850.
- TRIMEN, Roland (1840-1916). Poulton, E. B., P., *Proc. R. Soc. Lond. (B)* 91:xviii-xxvii, 1920; Poulton, E. B., *Proc. Linn. Soc. Lond.* 129:76-78, 1916-17; Poulton, E. B., *Nature* 79:485-486, 1916.
- TROOP, James (1853-1941). Davis, J. J., P., *Proc. Indiana Acad. Sci.* 41:59, 1932; A., l. c. 51:11-12, 1942; Osborn, H., P., *Fragments Ent. Hist.* 2:117-118, 1946.
- TROST, Alois (1850-1909). A., *Ent. Rundschau* 27:10, 1910.
- TRYON, Henry (1856-1943). A., *Journ. Austr. Inst. Agr. Sci.* 10:44, 1944; A., P., *Queensland Agr. Journ.* 58:61-62, 1944; A., B., P., l. c. 32:176-183, 1929; Chisholm, A. H., *Victorian Nat.* 60:128, 1943; Musgrave, A., B., *Bibliog. Austr. Ent. pp.* 323-326, 1932.
- TSCHITSCHÉRINE, Tichon Sergeiewitsch (1869-1904). Daniel, K., *Münch. Koleopt. Ztschr.* 2:389-390, 1906.
- TUELY, N. C. (-1879). Carrington, J. T., *Entomologist* 12:64, 1879.
- TUGWELL, William Henry (1831-1895). Meldola, R., *Trans. Ent. Soc. Lond. (Proc.)*: lxxii, 1895.
- TUINEN, Klaas Bisschop van (1840-1905). Van Rossum, A. J., P., *Tijdschr. Ent.* 49:234-236, 1906.
- TURNER, Alfred Jefferis (1861-1947). Remington, J. E., P., *Lepidopterists' News* 2:48, 82, 1948; Musgrave, A., B., *Bibliog. Austr. Ent. pp.* 326-329, 1932; Diakonoff, A., *Ent. Berichten* 12:329-330, 1949; Williams, C. B., *Proc. R. Ent. Soc. Lond. (C)* 13:68, 1948-49; Osborne, G. D., *Proc. Linn. Soc. N. S. Wales* 73:ii, 1948.
- TURNER, Charles (1809-1868). Smith, F., *Entomologist* 4:107-108, 1868; A., *Ent. Mo. Mag.* 5:25, 1868.
- TURNER, Rowland Edwards (-1945). Benson, R. B., *Ent. Mo. Mag.* 82:47, 1946; Benson, R. B., *Nature* 157:221, 1946.
- TUTT, James William (1858-1911). A., *Nature* 85:343, 1911; Poskin, J., et al., *Rev. Mens. Soc. Ent. Namuroise* 11:18-19, 1911; Chapman, T. A., *Zoologist* 69:75-76, 1911; Dixey, F. A., *Trans. Ent. Soc. Lond. (Proc.)*:lxxxvii-lxxxviii, 1910 (1911).
- TYCHSEN, Olaf (Olaus) Gerhard (1734-1815). Rose, H. J., *New Gen. Biog. Dict.* 12:297, 1850.
- TYTLER, Harry C. (-1939). Talbot, G., *Journ. Bombay N. H. Soc.* 41:409, 1939.
- UHAGON Y VEDIA, Serafina de (1845-1904). A., *Insekten-Börse* 21:227, 1904; Martínez de la Escalera, M., B., P., *Bol. Soc. Españ. Hist. Nat.* 4:287-291, 1904.
- UHLER, Philip Reese (1835-1913). Champion, G. C., *Ent. Mo. Mag.* 50:43, 1914.
- UHRVYCK, Ferdinand (-1909). A., *Ent. Rundschau* 27:22, 1910.
- ULBRICH, Ede (Eduard) (1854-1917). Kertész, A., B., P., *Rovartani Lapok* 24:97-100, 131, 1917.

- ULLMANN, Axel Conrad (1840-). Munster, T., P., Norsk Ent. Tidsskrift 1:209-211, 1923.
- UNGER, Franz (1800-1870). Ratzeburg, J. T. C., Forstwissenschaftliches Schriftsteller-Lexikon pp. 496-498, 1874.
- URBAN, Carl (1865-1941). Borchert, W., B., Ent. Blätter 37:170-173, 1941; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 8:286, 1941.
- URQUHART, Arthur T. (-1916). Bonnet, P., P., Bibliographia Araneorum p. 43, 1945.
- UYTTENBOOGAART, Daniel Louis (1872-1947). MacGillavry, D., Ent. Berichten 12:169-170, 1947; MacGillavry, D., B., P., Tijdschr. Ent. 89:1-9, 1946 (1948); Horion, A., Koleopt. Zeitschrift 1:158-159, 1949.
- UZEL, Jindrich (1868-1946). Cermak, I. K., B., Acta Soc. Zool. Cechosl. 11:13-17, 1947; Heyrovsky, L., P., Acta Soc. Ent. Cechosl. 44:72-74, 1947.
- VALCK LUCASSEN, Franz Titus (-1939). De Beaux, O., Ann. Mus. Civ. Stor. Nat. Genova 60:(3), 1940.
- VALLISNIERI, Antonio (1661-1730). Eiselt, J. N., Geschichte, System. und Literatur der Insectenk. pp. 29-30, 1836; Rose, H. J., New Gen. Biog. Dict. 12:325-326, 1850.
- VANDELLI, Domenico (1735-1816). Rose, H. J., New Gen. Biog. Dict. 12:330, 1850.
- VAN DER WEELE, Herman Willem (1879-1910). A., Ent. News 22:287-288, 1911; Jacobson, G. G., Rev. Russe Ent. 11:314, 1911.
- VAN DER WULP, Frederik Maurits (1818-1899). A., P., Insekten-Börse 17:9, 1900.
- VAN DUZEE, Edward Payson (1861-1940). A., P., Calif. Acad. Sci. Acad. News Letter 7:4 pp. (unnumbered) 1940; Osborn, H., Fragments Ent. Hist. 2:118-120, 1946.
- VAN OORT, Eduard Daniel (1876-1933). Bayer, C., P., Zool. Meded. 16:263-265, 1933.
- VAN VOORST, John (1804-1898). McLachlan, R., Ent. Mo. Mag. 34:214-215, 1898.
- VAULOGER DE BEAUPRÉ, Marcel (-1904). Daniel, K., Münch. Koleopt. Ztschr. 2:389, 1906.
- VAZQUEZ FIGUEROA Y CANALES, Aurelio (-1910). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:180, 1919.
- VÉLEZ DE ARCINIEGA, Francisco (-). Dusmet y Alonso, J. M., Bol. Soc. Ent. España 2:77, 1919.
- VELLAY, Imre (Emerich) (1850-1898). Jablonowski, J., Rovartani Lapok (Budapest) 5:180-186; l. c. 5(9):24, 1898.
- VERHOEFF, Karl Wilhelm (1867-1944). Burr, M., Ent. Record 58:157, 1946; "F. R.," Anz. f. Schädlingk. 14:23, 1938.
- VERRALL, George Henry (1848-1911). Austen, E. E., et al., Zoologist 69:394-396, 1911; Jacobson, G. G., Rev. Russe Ent. 11:462, 1911.
- VERSLUYS, Jan (1873-1939). Grobben, K., Akad. Wiss. Wien. Almanach, 1939 pp. 206-208, 1940.
- VETH, Huibert Johannes (1846-1917). Everts, E., P., Tijdschr. v. Ent. 60:271-274, 1917.
- VIALLANES, Henry (1856-1893). A., B., Bull. Soc. Philom. (8) 5:205-211, 1893; Bouvier, E. L., B., Ann. Sci. Nat. (Paris), Zool. (7) 15:353-397, 1893.
- VIDA, Marcus Hieronymus (Marco Girolamo) (1490-1566). Rose, H. J., New Gen. Biog. Dict. 12:363-364, 1850.
- VIERTL, Adalbert (1831-1900). Aigner, L., B., P., Rovartani Lapok (Budapest) 7:112-113, l. c. 7(6):11, 1900.
- VIGORS, Nicholas Aylward (1787-1840). Wilmot, R. W., Proc. Linn. Soc. Lond. 1:106-107, 1841; Rose, H. J., New Gen. Biog. Dict. 12:366, 1850.
- VILLERS, Charles Joseph de (1724-1810). Eiselt, J. N., Geschichte, Syst. und Literatur der Insectenk. p. 53, 1836.
- VIMMER, Anton (1864-1941). Obenberger, J., P., Acta Soc. Ent. Bohemiae 38:65, 1941; Maran, J., B., P., Acta Soc. Zool. Cechosl. 10:11-19, 1945-46; Sachtleben, H., Arb. Morph. Taxon. Ent. Berlin-Dahlem 9:65, 1942.
- VIRGILIUS MARO, Publius (70 B. C.-19 B. C.). Rose, H. J., New Gen. Biog. Dict. 12:374-375, 1850; Pellett, K. L., Amer. Bee Journ. 69:238-240, 1929.
- VITZTHUM VON ECKSTAEDT, Hermann Ludwig Wilhelm (1876-1942). A., Zool. Anzeiger 138:248, 1942; Hase, A., P., Ztschr. f. Parasitenk. 12:501-506, 1942; Sachtleben, H., Arb. Physiol. Angew. Ent. Berlin-Dahlem 9:127, 1942.

- VIVIAN, Henry Wyndham (1868-1901). Richardson, N. M., *Ent. Mo. Mag.* 38:13, 1902.
- VODOZ, Georges (1873-1903). A., *Insekten-Börse* 20:410, 1903; Ste. Claire Deville, J., B., *Riv. Coleott. Ital.* 1:240-242, 1903; Ste. Claire Deville, B., *Münch. Koleopt. Ztschr.* 2:93-94, 1904.
- VOGT, Alfred (1879-1943). Hess, W. R., P., *Verh. Schweiz. Naturf. Ges.* 124:350-355, 1944; Fisher, H., *Vierteljahresh. Naturf. Ges. Zürich* 89:66-67, 1944; Hess, W. R., P., *l. c.* 89:136-140, 1944.
- VOGT, Artur (1869-1932). A., B., P., *Internat. Ent. Ztschr.* 26:32-36, 1932.
- VOGT, Carl Chrsotph (1817-1895). "M. B.," *Rev. Suisse Zool.* 3:frontispiece, 1895.
- VOGT, Heinrich (1776-1840). A., *Jahresh. Ver. Naturk. Mannheim* 73:75:6-7, 1906-08; A., *l. c.* 7:15-19, 1840.
- VOIGT, Friedrich Siegmund (1781-1850). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 86-87 (footnote), 1874.
- VOIGTS, Hans (-1905). A., *Insekten-Börse* 22:62, 1905; A., *Wiener Ent. Zeit.* 24:118, 1905.
- VOLCK, William Hunter (1879-1943). Essig, E. O., *Bull. Calif. Dept. Agr.* 32:145-147, 1943; Osborn, H., *Fragments Ent. Hist.* 2:120, 1946.
- VOLKONSKY, Michel (1907-1942). A., *Arch. Inst. Pasteur Algérie* 20:292, 1942.
- VOLTAIRE, François Marie Arouet (1694-1778). Rose, H. J., *New Gen. Biog. Dict.* 12:382-284, 1850.
- VOLXEM, Camille van (1848-1875). Putzeys, J. A. A. H., *Ann. Soc. Ent. Belg.* 18 (C. R.) ciii-cvi, 1875.
- VORBRINGER, Gustav (1846-1910). Kuhnt, P., B., *Deutsche Ent. Ztschr.* pp. 716-717, 1910; Hubenthal, W., *Ent. Blätter* 6:300, 1910; A., *Ent. Rundschau* 27:150, 1910.
- VORBRÖDT, Karl (-1932). A., *Insekten-Börse* 49:153, 1932.
- VORIS, Ralph (1902-1940). Osborn, H., *Fragments Ent. Hist.* 2:120, 1946.
- VOSSELER, Julius (1861-1933). Lindner, E., B., P., *Jahresh. Ver. Vaterl. Naturk. Württemb.* 90:xl-xlv, 1934.
- WACHANRU, Marie (1821-1853). Mulsant, E., *Opuscles Ent.* 2:145-154, 1853.
- WAGNER, A. C. Wilhelm (1866-1942). Kröber, O., B., P., *Verh. Ver. Naturw. Heimatforsch. Hamburg* 29:x-xiv, 1947; Sachtleben, H., *Arb. Morph. Taxon. Ent. Berlin-Dahlem* 9:65, 1942.
- WAGNER, Arno (-1919). Astfäller, B., *Internat. Ent. Ztschr.* 14:129-130, 1920.
- WAGNER, Fritz (1873-1938). Reisser, H. et al., B., P., *Ztschr. Österr. Ent. Ver.* 23:105-109, 1938.
- WAGNER, Nicolai Petrowitsch (1829-1907). Nassonov, N. V., *Bull. Acad. Sci. St. Petersb.* (6) 1:203-204, 1907.
- WAGNER, Samuel (1798-). Pellett, K. L., *Amer. Bee Journ.* 69:504-505, 1929.
- WAGNER, Wladimir Alexandrowitch (1849-1934). Bonnet, P., P., *Bibliographia Araneorum* p. 49, 1945.
- WAHNES, Carl (1835-1910). A., *Ent. Rundschau* 27:34, 45, 1910; Kuhnt, P., *Deutsche Ent. Ztschr.* p. 330, 1910.
- WAINWRIGHT, Colbran Joseph (1867-1949). Fraser, F. C., *Ent. Mo. Mag.* 85:49-50, 1949; Williams, C. B., *Proc. R. Ent. Soc. Lond. (C)* 13:68-69, 1948-49.
- WAITE, Merton Banway (-1945). A., *Washington Post, Thursday, June 7 p. 12*, 1945.
- WAKEFIELD, Charles Marcus (-1902). A., *Ent. Record* 38:135, 1902; A., *Ent. Mo. Mag.* 38:135, 1902; Fowler, W. W., *Trans. Ent. Soc. Lond. (Proc.)* lviii, 1902.
- WALCH, E. W. (-1934). Lien-Teh, W., et al., *Trans. 9th Cong. Nanking, China*, 1934, p. vii, 1935.
- WALCKENAER, Charles Athanase (1771-1852). Bonnet, P., P., *Bibliographia Araneorum* pp. 31-32, 1945.
- WALCOTT, W. H. L. (1790-1869). Newman, E., *Entomologist* 4:294, 1869.
- WALDEN, Benjamin Hovey (1879-1946). Friend, R. B., P., *Journ. Econ. Ent.* 39:423, 1946; Friend, R. B., P., *Conn. State Ent. Rpt.* 45 (Bull. 501):8, 1946.
- WALES, Robert Webster (1889-1948). Gerry, B. I., *Univ. of Mass. Fernald Club Yearbook* 18:37-38, 1949.

- WALKER, Francis (1809-1874). Saunders, S. S., *Trans. Ent. Soc. Lond. (Proc.)*:xxxvi-xxxvii, 1874; Lizer y Trelles, C. A., *Curso de Entomologia* 1:13, 1947.
- WALKER, Francis Augustus (1841-1905). "B. D. J.," *Proc. Linn. Soc. Lond.* pp. 55-56, 1904.
- WALKER, Fred Winter (1892-). A., *Florida Ent.* 18:28-29, 1934.
- WALKER, James John (1851-1939). Donisthorpe, H., P., *Ent. Record* 51:67-69, 1939; Hobby, B. M., *Journ. Soc. Brit. Ent.* 2:43-44, 1939; Grensted, L. W., *Rpt. Ashmolean N. H. Soc.* pp. 22-23, 1938 (1939); Poulton, E. B., *Oxford Mag.* 57:399, 1939.
- WALL, Robert Emerson (1903-1933). Strand, A. L., *Journ. Econ. Ent.* 27:297-298, 1934; Hoffmann, W. E., B., P., *Lingnan Sci. Journ.* 13:333-334, 1934.
- WALLACE, Alfred Russel (1823-1913). Poulton, E. B., *P. Proc. R. Soc. Lond. (B)* 95:i-xxxv, 1923-24; Newman, E., *Zoologist* 12:4226-4227, 1854; Poulton, E. B., *Nature* 92:347-349, 1913; Poulton, E. B., *Zoologist* 71:468-471, 1913; A., *Knowledge* 10:456, 1913; Mestre, A., B., *Mem. Soc. Cubana Hist. Nat.* 3:228-242, 1918; von Hagen, V. W., *Green World of the Naturalists* pp. 213-222, 1948.
- WALLETIN, Ignaz (-1934). "W.," *Ztschr. Österr. Ent.-Ver.* 19:62-63, 1934.
- WALLER, Thomas Naunton (1863-1942). A., *Trans. Suffolk Nat. Soc.* 5(1):xxviii-xxix, 1942.
- WALSCH, Josef (1866-1934). Hornstein, K., *Ztschr. Österr. Ent.-Ver.* 20:29, 1935.
- WALTER-GROSSMANN, Charles (1884-1946). Lundblad, O., B., P., *Ent. Tidskrift* 69:69-71, 1948.
- WALTHER, Hans. (1868-1933). Möbius, E., B., P., *Iris* 47:191-194, 1933; Koch, M., et al., P., *Internat. Ent. Ztschr.* 27:556, 1934.
- WALTON, Lee Barker (1871-1937). Osborn, H., *Science* 88:49, 1938; Osborn, H., *Fragments Ent. Hist.* 2:120-121, 1946.
- WANGERIN, Walther (-1938). A., *Ent. Zeitschrift* 52:93, 1938.
- WANKA VON LENZENHEIM, Theodor (1871-1932). Hetschko, A., *Ent. Nachrichtenbl.* 6:90, 1932.
- WARD, Henry Baldwin (1865-1945). A., P., *American Nat.* 80:25-26, 1946.
- WARD, Ivor Jesmond (-1947). Buckell, R., *Canadian Ent.* 79:39, 1947; Buckell, E. R., P., *Proc. Ent. Soc. Br. Col.* 44:35, 1947.
- WARLOE, Hans (1852-1939). Natvig, L. R., B., P., *Norsk Ent. Tidsskrift* 5:190-192, 1940; Natvig, L. R., P., *I. c.* 3:1, 1932; Hellén, W., *Notulae Ent.* 23:59, 1943.
- WARNE, Norman Dalziel (1868-1905). A., *Entomologist* 38:288, 1905.
- WASASTJERNA, Björn Rudolf (1860-1928). Forsius, R., P., *Notulae Ent.* 8:65-67, 1928.
- WASMAN, Erich (1859-1931). Wardell, M., *Wasmann Collector* 3:1-2, 1938; Wiedemann, C. J., P., *I. c.* 5:1-8, 41-46, 1942; Schmitz, H., P., *Wasmann's Die Ameisen, die Termiten und ihre Gäste* pp. vii-xviii, 1934; Gemelli, A., *Atti Pontif. Accad. Sci. Nuovi Lincei (Rome)* 84:489-508, 1931.
- WATASÉ, Shosaburo (1862-1929). Lillie, F. R., et al., *Science* 71:577-578, 1930.
- WATERHOUSE, Frederick George (1815-1898). A., *Ent. Mo. Mag.* 35:16, 1899; Musgrave, A., *Bibliog. Austr. Ent.* pp. 340-341, 1930.
- WATKINS, Charles James (1846-1906). Waterhouse, C. O., *Trans. Ent. Soc. Lond. (Proc.)*:xcvii, 1907.
- WATSON, Edward Yerbury (-1897). A., *Ent. Mo. Mag.* 33:283, 1897; Trimen, R., *Trans. Ent. Soc. Lond. (Proc.)*:lxxi-lxxii, 1897.
- WATSON, Frank Edward (1877-1947). A., *Journ. N. Y. Ent. Soc.* 55:274, 1947.
- WATSON, Joseph Ralph (1874-1946). Tissot, A. N., P., *Florida Ent.* 28:57-59, 1946; Tissot, A. N., *Ann. Ent. Soc. Amer.* 39:345-346, 1946; Bailey, S. F., B. only, *Florida Ent.* 30:17-24, 1947.
- WATSON, William (1715-1787). Rose, H. J., *New Gen. Biog. Dict.* 12:428-429, 1850.
- WATTENWYL, Carl Brunner von (1823-1914). A., *Ent. Record* 27:213, 1915; Bolívar, I., *Bol. R. Soc. Españ. Hist. Nat.* 15:161-166, 1915.
- WAUTIER, Abbé (1833-1910). Poskin, J., et al., *Rev. Mens. Soc. Ent. Namuroise* 10:57-58, 1910.
- WEBBER, Ray Trask (1884-1948). Crossman, S. S., et al., *Journ. Econ. Ent.* 41:340, 1948.
- WEBER, Ludwig (1855-1922). Müller, C. H., B., *Ent. Blätter* 18:113-114, 1922.

- WEBSTER, Francis Marion (1849-1916). Davis, J. J., *P.*, Proc. Indiana Acad. Sci. 41:58-59, 1932.
- WEED, Clarence Moores (1864-1947). *A.*, Science 106:125, 1947.
- WEIR, John Jenner (1822-1894). *A.*, Proc. Linn. Soc. Lond. pp. 37-38, 1892-94; *A.*, *P.*, Science Gossip, n. s. 1:49-50, 1894; Elwes, H. J., Trans. Ent. Soc. Lond. (Proc.):li, 1894.
- WEISE, Julius (1844-1925). Korschefsky, R., *B.*, Ent. Blätter 24:175-186, 1928; Hedicke, H., Deutsche Ent. Ztschr. p. 88, 1925.
- WEISE, Paul (-1902). Kraatz, G., Deutsche Ent. Ztschr. 47:174, 1903.
- WEISSMANN, Friedrich Leopold August (1834-1914). Poulton, E. B., Proc. R. Soc. Lond. (B) 89:xxxvii-xxxiv, 1915-17; Parker, W. N., et al., Proc. Linn. Soc. Lond. 127:33-37, 1914-15.
- WEITH, R. J. (1847-1902). Davis, J. J., *P.*, Proc. Indiana Acad. Sci. 41:54, 1931.
- WELITSCHKOWSKY, Vladimir Alexevich (1857-1927). Konakov, N. N., *B.*, Acta Univ. Voroneg 9 (Sect. Zool.):174-182, 1937.
- WELLCOME, Henry Solomon (1853-1936). Wenyon, C. M., *P.*, Obit. Notices Fellows Roy. Soc. Lond. 2:229-238, 1938; *A.*, *P.*, Amer. Journ. Pharmacy 108:313-319, 1936; *A.*, *P.*, Clinical Med. & Surg. 43:472, 1936; Defosses, P., La Presse Méd. 44:1363-1364, 1936.
- WELLMAN, John Richard (1833-1894). Adkin, R., Entomologist 27:360, 1894; *A.*, Ent. Mo. Mag. 31:31, 1895.
- WENNINGER, Francis (1888-1940). *A.*, Proc. Indiana Acad. Sci. 50:12-13, 1941.
- WERNER, Franz (1867-1939). Pintner, T., Akad. Wiss. Wien. Almanach 89:210-213, 1939 (1940); Wettstein, O. von, *B.*, *P.*, Ann. Naturh. Mus. Wien 51:8-53, 1940; Pusching, R., Carinthia II, 130:141-143, 1940; Wettstein, O. von, *P.*, Blätter f. Aquar. u. Terr.-Kunde 48:141-142, 1937; Antonius, O., *P.*, Zool. Garten, n. f. 11:186-188, 1939; Mahendra, B. C., Nature 143:711, 1939.
- WESCHÉ, Walter Francis Frederick (1857-1910). *A.*, Journ. Quekett Micro. Club (2) 11:145-146, 1910.
- WESSEL, A. B. (-1940). Natvig, L. R., Norsk Ent. Tidsskrift 6:123, 1942.
- WEST, August (1874-1949). Hansen, V., *B.*, *P.*, Ent. Meddelelser 25:333-338, 1949.
- WEST, Thomas (-1879). Sharp, W. E., Entomologist 12:208, 1879.
- WEST, William Roy (1920-1944). Lyle, C., *P.*, Journ. Econ. Ent. 37:329, 1944; Vorhies, C. T., Ann. Ent. Soc. Amer. 37:129, 1944; Lyle, C., *l. c.* 38:144, 1945.
- WESTERMANN, Bernt Wilhelm (1781-1868). Spärck, R., *P.*, Vidensk. Medd. Dansk Naturh. For. Kobenh. 95:37-38, 1933.
- WESTRING, Niklas (Nicolas) (1797-1882). Bonnet, P., *P.*, Bibliographia Araneorum p. 34, 1945.
- WESTWOOD, John Obadiah (1805-1893). Weir, J. J., Ent. Record 4:24, 1893; Wade, J. S., *P.*, Nature Mag. 22:229, 1933; *A.*, *P.*, Insekten-Börse 10:1, 1893; Bordas, L., *P.*, Insecta 12:5-6, 1923.
- WEYENBERGH, Hendrik (1842-1885). *A.*, Ent. Mo. Mag. 22:143-144, 1885; Lizer y Trellés, C. A., Curso de Entomologia 1:32, 1947.
- WEYMER, Gustav (-1914). Kuhnt, P., Deutsche Ent. Ztschr. p. 356, 1914.
- WHEELER, George (1858-1947). Turner, H. J., Ent. Record 60:55-56, 1948; *A.*, Lepidopterists' News 2:67, 1948.
- WHEELER, William Morton (1865-1937). Imms, A. D., Nature 139:827-828, 1937; Eichmann, H., *P.*, Ztschr. Angew. Ent. 22:514-515, 1935; Cockerell, T. D. A., Scientific Monthly 44:569-571, 1937; Zeck, E. H., Australian Nat. 10:147-148, 1938; Birabén, M., *P.*, Rev. Mus. La Plata (Secc. Ofic.):137-139, 1937 (1938); Molino, J. F., Physis (Arg.) 12:398, 1938; Osborn, H., Fragments Ent. Hist. 2:121-122, 1946.
- WHIFFIN, Walter Harry (-1887). Riley, N. D., Proc. So. Lond. Ent. & N. H. Soc. 1923-24 p. 75, 1924.
- WHITE, Francis Buchanan (1842-1894). Coates, H., *B.*, *P.*, Trans. Perthshire Soc. 2 (Proc.):lv-lxvi, 1895; Trail, J. W. H., *B.*, *P.*, Ann. Scottish N. H. pp. 73-91, 1895.
- WHITE, Gershom Franklin (1873-1937). Dove, W. E., Journ. Parasitol 23:579-580, 1937.
- WHITE, Gilbert (1720-1793). Rose, H. J., New Gen. Biog. Dict. 12:473, 1850;

- Mullens, W. H., *Hastings & E. Sussex Nat.* 1:153-173, 1909.
- WHITE, William Farren (1834-1899). *A.*, *Ent. Mo. Mag.* 35:216, 1899.
- WHITEHOUSE, Harold Beckwith (1883-1943). Cockayne, E. A., *Ent. Record* 55:94, 1943.
- WHITELY, Henry, Jr. (1844-1892). Godman, F. D., *Trans. Ent. Soc. Lond. (Proc.)*: lvi, 1892.
- WHITMARSH, Raymon Dean (1885-1946). *A.*, *Mass. State Coll. Fernald Club Year-book* 16:25, 1947.
- WHITNEY, Lehr Artman (1890-1945). Fullaway, D. T., et al., *P.*, *Proc. Haw. Ent. Soc.* 12:492a-492b, 1946.
- WHYMPER, Edward (1840-1911). Soldanski, H., *Deutsche Ent. Ztschr.* p. 99, 1912; von Hagen, V. W., *Green World of the Naturalists* pp. 264-279, 1948.
- WIEDEMANN, Christian Rudolph (1770-1840). Lizer y Trelles, C. A., *Curso de Entomologia* 1:11-12, 1947.
- WIESE, Gustav Ernst Friedrich (1809-). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 502-507, 1874.
- WILEMAN, Alfred Ernest (1860-1929). West, R. J., *B.*, *Zephyrus (Fukuoka)* 2:140-144, 1930.
- WILKIN, Simon (-1862). Smith, F., *Trans. Ent. Soc. Lond. (3)* 1 (Proc.):123, 1862-64.
- WILKINSON, Samuel James (1816-1903). *A.*, *Ent. Record* 15:275, 1903; Ellison, N. F., *P.*, *Northwestern Nat.* 20:145-148, 1946.
- WILKINSON, Thomas (-1876). *A.*, *Ent. Mo. Mag.* 12:279, 1876; Westwood, J. O., *Trans. Ent. Soc. Lond. (Proc.)*:xliii, 1876.
- WILLARD, Harold Francis (1884-1939). Osborn, H., *Fragments Ent. Hist.* 2:122, 1946.
- WILLIAMS, James Trimmer (-1894). Adkin, R., *Entomologist* 27:228, 1894.
- WILLIAMS, Roswell Carter, Jr. (1869-1946). *A.*, *Ent. News* 57:34, 1946; Bell, E. L., *P.*, *l. c.* 57:167-171, 1946; Hayward, K. J., *Rev. Soc. Ent. Arg.* 13:344-345, 1947; *A.*, *Lepidopterists' News* 1:7, 1947.
- WILLIAMSON, Edward Bruce (1877-1933). Davis, J. J., *P.*, *Proc. Indiana Acad. Sci.* 41:51, 1932.
- WILLIS, Thomas (1621-1675). Rose, H. J., *New Gen. Biog. Dict.* 12:504-505, 1850.
- WILLIS, Warren Jennison (-1941). Mickel, C. E., *Ann. Ent. Soc. Amer.* 35:128, 1942; Osborn, H., *Fragments Ent. Hist.* 2:123, 1946.
- WILLISTON, Samuel Wendell (1852-1918). Woodward, A. S., *Quart. Journ. Geol. Soc. Lond.* 75:lv-lvi, 1919; Woodward, A. S., *Geol. Mag.* (6) 5:539-560, 1918.
- WILLKOMM, Heinrich Moritz (1821-1895). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 507-512, 1874.
- WILLUGHBY, Francis (1635-1672). Rose, H. J., *New Gen. Biog. Dict.* 12:506, 1850.
- WILSON, Cecil Cline (1896-1948). Noble, W. B., et al., *P.*, *Journ. Econ. Ent.* 41:525-526, 1948.
- WILSON, Edwin (-1915). Scott, H., *Ent. Mo. Mag.* 51:223, 1915.
- WILSON, Owen S. (-1890). *A.*, *Entomologist* 23:352, 1890.
- WINDRATH-FREY, Walter (-1947). Culatti, J., *Mitt. Schweiz. Ent. Ges.* 21:297, 1948.
- WINGELMÜLLER, Alois (1848-1920). Heikertinger, F., *P.*, *Koleopt. Rundschau* 23:144-145, 1937.
- WINKLER, Albert (-1945). Jarvis, C. M., *Ent. Mo. Mag.* 82:160, 1946; Schedl, K. E., *Zentralbl. Gesamtgeb. Ent.* 1:63, 1946.
- WINN, Albert F. (-1935). Moore, G. A., *P.*, *Canadian Ent.* 80:22, 33, 1948.
- WINSLOW, James Benignus (1669-1760). Rose, H. J., *New Gen. Biog. Dict.* 12:514, 1850.
- WINTERS (WINTERSTEINER), Frederick Edward (1885-1946). Chamberlain, F. K., *B.*, *Bull. Bklyn. Ent. Soc.* 42:72-74, 1947.
- WISTRÖM, Johan Alfred (1830-1896). Aurivillius, C., *P.*, *Ent. Tidskrift* 17:293-297, 1896.
- WOCKE, Georg (1849-1907). *A.*, *Ent. Zeitschrift* 21:182, 1907.
- WOCKE, Maximilian Ferdinand (1820-1906). Krancher, O., *P.*, *Ent. Jahrbuch* 17:198, 1908.
- WOLLASTON, Edith (-1911). Bethune-Baker, G. T., *Ent. Record* 23:325, 1911.

- WONFOR, Thomas W. (-1878). *A.*, *Ent. Mo. Mag.* 15:167-168, 1878; Goss, H., *Entomologist* 40:259-260, 1878; Goss, H., *Naturalist* (Yorkshire) 4:75-76, 1878.
- WOOD, H. Worsley (1878-1943). "E. A. C." *Ent. Record* 55:78, 1943.
- WOOD, John Henry (1844-1914). *A.*, *B.*, *Ent. Mo. Mag.* 50:277-279, 1914.
- WOODTHORPE, Edward (-1899). "J. E. M." *Naturalist* (Lond.) p. 288, 1899.
- WOODWORTH, Charles William (1865-1940). Essig, E. O., *Science* 92:570-572, 1940; Essig, E. O., *B. only*, *Journ. Econ. Ent.* 34:595-596, 1941; Sachtleben, H., *Arb. Physiol. Angew. Ent.* Berlin-Damlem 8:213, 1941; Osborn, H., *P.*, *Fragments Ent. Hist.* 2:123, 1946.
- WORM, Olaus (1588-1654). Rose, H. J., *New Gen. Biog. Dict.* 12:530, 1850.
- WORTHLEY, Leon Howard (1877-1937). Osborn, H., *Fragments Ent. Hist.* 2:123, 1946.
- WOTTON, Edward (1492-1555). Eiselt, J. N. *Geschichte, Syst. und Literatur der Insecten*, pp. 15-16, 1836; Rose, H. J., *New Gen. Biog. Dict.* 12:531, 1850.
- WRATISLAW, Albert Henry (-1892). *A.*, *Entomologist* 25:328, 1892.
- WULLSCHLEGEL, Arnold (1849-1912). Bayer, C., *Ent. Zeitschrift* 26:144, 1912; Wheeler, G., *Ent. Record* 24:317, 1912.
- WULP, Frederik Maurits van der (1818-1899). *A.*, *P.*, *Insekten-Börse* 17:9, 1900; Snellen, P. C. T., *Tijdschrift Ent.* 43:1-11, 1900.
- WUTZDORFF, Hermann (1843-1909). Horn, W., *Deutsche Ent. Ztschr.* p. 113, 1910.
- YAMAGUCHI, Suteo (1908-1939). *A.*, *P.*, *Kontyu* 13:138, 1939.
- YLÖNEN, Pekka (1878-1928). Forsius, R., *Notulae Ent.* 8:64, 1928.
- YOUNG, John N. (-1898). *A.*, *Entomologist* 31:100, 1898; *A.*, *Naturalist* (Lond.) p. 179, 1898.
- YOUNG, Lawrence C. H. (-1907). *A.*, *Journ. Bombay N. H. Soc.* 18:184-185, 1907.
- YOUNG, Morris (1821-1897). *A.*, *Ent. Mo. Mag.* 33:283, 1897; Dunsmore, Ann. Scottish N. H. pp. 1-6, 1898; Trimen, R., *Trans. Ent. Soc. Lond. (Proc.)*:lxiii, 1897.
- ZACHARIAS, Otto (1846-1916). Thienemann, A., *B.*, *P.*, *Archiv Hydrobiol.* 11(4):i-xxiv, 1917.
- ZADDACH, Ernst Gustav (1817-1881). Schimmelpfennig, *Jahres-Ber. Schles. Ges. Vaterl. Cultur* (Breslau) 59:422, 1881.
- ZALESKY, Milos (-1944). Stěpánek, O., *Acta Soc. Zool. Cechosl.* 10:39-40, 1946.
- ZANG, Richard (1884-1906). Horn, W., *Deutsche Ent. Ztschr.* p. 12, 1906; Daniel, K., *Münch. Koleopt. Ztschr.* 3:399, 1908.
- ZANTHIER, Hans Dietrich von (1717-1778). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* pp. 512-514, 1874.
- ZAPATER, Peter Bernardo (1816(?) -1907). Dusmet y Alonso, J. M., *Bol. Soc. Ent. España* 2:179-180, 1919.
- ZAVREL, Jan (1879-1946). Hrabě, S., *B.*, *P.*, *Acta Soc. Zool. Cechosl.* 11:18-24, 1947; Hoffer, A., *B.*, *P.*, *Acta Soc. Ent. Cechosl.* 36:1-4, 1939.
- ZELLER, Philipp Christoph (1808-1883). Stainton, H. T., *Stettiner Ent. Zeit.* 45:72-80, 1884; Homeyer, A. von, *l. c.* 47:294-299, 1886; Dohrn, C. A., *l. c.* 51:236-243, 1890.
- ZENKER, Christian Daniel (1765-1819). Germar, E. F., *Mag. der Ent.* 4:443, 1821.
- ZERNY, Hans (1887-1945). Wheeler, G., *Ent. Record* 58:131-132, 1946; Reisser, P., *Ztschr. Wien. Ent. Ges.* 30:49-51, 1946; Pittioni, B., *B.*, *P.*, *Ann. Naturh. Mus. Wien.* 56:558-563, 1948.
- ZETTERSTEDT, Johan Wilhelm (1785-1874). Ratzeburg, J. T. C., *Forstwissenschaftliches Schriftsteller-Lexikon* p. 125 (footnote), 1874; Saunders, S. S., *Trans. Ent. Soc. Lond. (Proc.)*:xxxv, 1874.
- ZIEMANN, Hans (-1939). Sachtleben, *Arb. Physiol. Angew. Ent.* 7:80, 1940.
- ZIKAN, José Francisco (1881-1949). Borgmeier, T., *B.*, *P.*, *Rev. Ent. (Brasil)* 20:647-652, 1949.
- ZIMMERMANN, Alois (1871-1929). Daniel K., *B.*, *P.*, *Koleopt. Rundschau* 15:240-243, 1930.
- ZIMMERMANN, Christian (1800-1867). Hagen, H. A., *Canadian Ent.* 21:53-57, 71-73, 1889.
- ZIMMERMANN, Johann Carl Heinrich (1845-1930). Zimmerman, W., *Verh. Ver. Naturw. Heimatforsch. (Hamburg)* 22:xv-xvii, 1930.

- ZINSER, Hans (1878-1940). Strong, R. P., *Science* 92:276-279, 1940; Mueller, J. H., *P., Journ. Bacteriol.* 40:747-753, 1940.
- ZNOJKO, Dmitri Vasilievich (1903-1933). Semenov-Tian-Shansky, A. P., *B., P., Bull. Plant Prot. Leningrad* (1) 8:73-78, 1934.
- ZOUFAL, Vladimír 1856-1932). Reitter, E., *P., Ent. Nachrichtenbl.* 7:37-38, 1933; *A., P., Vestnik Kubu Prirod. Prostejové* 23: 7-14, 1933.
- ZÜRN, Frédéric Antoine (1835-1900). Blanchard, R., *P., Archives Parasitol.* 3:644-645, 1900.
- ZUKOWSKY, Bernhard (-1949). Koch, M., *Ent. Zeitschrift* 59:65, 1949.

ADDENDA AND CORRIGENDA

Mathilde M. Carpenter, Bibliography of Biographies of Entomologists,
Amer. Midl. Nat. 33(1):1-116, 1945.

- p. 1. For Abbott, read Abbot.
- p. 2. For Adamson, read Adanson.
- p. 3. For Edmond André read Jacques Ernest Edmond.
- p. 5. Under Bargagli, insert 1844 for date of birth.
- p. 6. In line 3 under Bates, Henry Walter, read l-liv.
- p. 9. Under Bezzi, Mario read 1868 for 1869.
 Under Blackwall, John, 1790 for 1789.
- p. 10. In line 5 under Boheman read lv-lvi for iv.
- p. 11. Under Borch read Borrichius and under Borrichus read Borrichius.
- p. 12. In line 3 under Boyer de Fonscolombe read 337 for 336.
- p. 13. In line 3 under Brölemann read 38 for 33.
- p. 14. Under Brunetti read 1862 for 1864.
 In line 7 under Burmeister read clx for cxxix. British Museum lists his name as Carl Hermann Conrad, Library of Congress as Karl Hermann Konrad, and Horn & Schenking, *Index Litt. Ent.*, p. 157, as Herman Carl Conrad.
- p. 16. Under Buquet read (1807-1889) for (1807-1899).
- p. 17. Under Chagas read Ribeiro for Ribiero.
- p. 20. Under Chavannes read Auguste for August.
- p. 21. Under Costa read 1823 for 1828.
- p. 21. Under Crotch, 3rd line, read *Ent. Mo. Mag.* 11 for 2.
- p. 22. Under Cuthbertson, line 2, read Munro, H. K. for A. K.
- p. 22. For Dahl, Friedrich read Friedrich Theodor Dahl.
 Under Darwin, Charles Robert read 1809 for 1808.
- p. 23. Under Deville, 3rd line, insert *B.*, after Donisthorpe, H., and in line 4 read 219 for 216.
- p. 24. Under Dietze read 1935 for 1925.
- p. 25. Under Dollman read Chune for Clune.
- p. 26. Under Dufour read Leon Jean Marie for Dufour, Leon.
 Under Duges read 1826 for 1827.
 Under Dutrochet read *Zeitung* for *Zeitung*.
- p. 28. Under Eisen, read (1847-1940) for (1847-1941).
 Under Ehrhorn read Macfarlane for Macfarline.
- p. 29. Under Eschscholtz, 3rd line, read 9: 68, 98, for 9: 98.
 Under Evans, William read 1851 for 1850.
- p. 30. Under Fantham read 1876 for 1877.
 Under Fassl read Anton Heinrich for A. H.
- p. 31. Under Fischer read Leopold Heinrich for Heinrich Leopold and add 1817 for date of birth.
 Under Fischer von Waldheim read (1771-1853) for (1771-1854).
- p. 32. Under Flint read Pillsbury for Pillsbry.
- p. 33. Under Francois, Philippe add (1859-1908).
 Under Fraunfeld read Frauenfeld.
- p. 34. Under Fruehstorfer read Fruhstorfer.
 Under Fuente read José Marie de la.

- p. 36. Under Gibson read Lester Ernest.
Under Giglio-Tos, line 2, read 58 for 68.
Under Gillette, line 2, read 120 for 119.
- p. 37. Under Girard, line 1, read Ent. Mo. Mag. 23: 113, 1886.
Under Glenn, read (1867-1937) for (1867-1938).
- p. 38. Under Götschmann read 1852 for 1850.
- p. 39. Under Gredler read Vincenz for Vinzenz.
To Grenier add Auguste Jean François.
- p. 41. Under Haase read 1865 for 1867.
- p. 45. Under Herz add (1853-1905), also Alfred before Otto.
Under Hetschko read Wien. Ent. Zeit. 50 for 33.
Under Heyden, Lucas read Dominicus for Diminicus.
- p. 46. For Hofman, Ottmar read Hofmann.
Under Honrath read (1837-1893) for 1894.
- p. 47. Under Horn, Walther, line 3, read 201-222, for 202.
- p. 48. Under Hutton, omit second Hutton, read 1905 for 1903.
- p. 49. Under Jacoby, line 4, insert 32-35 after 16.
Under Jakovlev, Alexandre, read lxxvi for lxxii.
- p. 52. Under Killias insert 8 before 373-375.
Under Kirkaldy, line 4, should read 12 before 111-113.
- p. 54. Under Koch after Ludwig insert Carl Christian.
Under Kopec read 655 for 635.
- p. 55. Under Krulikowski read 24 for 26.
- p. 56. Under Kuwert read 1828 for 1829.
Under Lamb insert (1861-1941).
- p. 57. Read Lartigue for Lartigne.
- p. 59. After Le Peletier insert de St. Fargeau.
- p. 60. Under Leussler read Richard A. for R. A.
- p. 62. Under Lovett, line 3, insert B. 501-504 after 421-422.
- p. 63. Under Lutz, Adolfo read Neiva for Veiva.
Under Lynch-Arribálzaga insert 1854 for date of birth.
- p. 65. Under Martynov read 1879 for 1870.
Under Maskell, line 3, add p. 165.
- p. 67. Under Meinert read (1833-1912) for (1833-1903).
- p. 69. Under Meyrick, line 5, read Rev. for Riv.
Under Michelet read 1798 for 1789.
Under Mikan read 1844 for 1814.
Under Millière, line 2, insert Ann. Soc. Ent. France before (6) 7.
- p. 72. Under Mulsant, line 7, insert B. before L'Abeille.
Under Munster insert George after Thomas.
- p. 73. Under Neiva, line 2, insert B. before P.
- p. 74. Under Nickerl read Ottokar for Otokar.
Under Niepelt read 1862 for 1863.
Under Nowicki, line 1, read 272 for 270.
- p. 75. Under Oken insert Ludwig before Lorenz; line 4, insert Forschungen u. Fortschritte after P.
- p. 76. Oskar, John should be under John, Oskar.
- p. 77. After Pagenstecher insert Arnold.
- p. 78. Under Peckham read George Williams for George William.
Read Péringuey for Périnquey; insert 1855 as date of birth.
- p. 79. Under Philippi read Federico for Federigo.
Under Pickard-Cambridge read (1860-1905) for (1861-1905).
- p. 80. Under Pictet read 1879 for date of death.
- p. 81. Under Porter add 1868 for date of birth.
Under Prout add 1864 as date of birth.
Under Puengeler read 1857 for 1858.
- p. 86. Under Rivers insert John after James.
Under Robin insert Phillipe after Charles.
- p. 88. Under Rübsaamen add 1857 as birth date.
- p. 89. Under Russell, F. W., line 2, add 25 after 23:.

- Under Saint Cyr read 1826 for 1825.
- p. 93. Under Schreiter add 1877 as birth date.
Under Schrenk add Peter before Leopold.
Under Schwarz, Otto add Card Ernst.
- p. 94. Under Seidlitz add Karl Maria after Georg.
Under Seitz read 1860 for 1869.
- p. 95. Under Sharp, David, line 7, read cxxi for lxxi.
Under Shaw, line 3, read 1932 for 1931.
- p. 96. Under Shuckard insert William Edward.
Under Siewers read 1815 for 1814.
- p. 97. Under Smith read John Bernhardt for John Bernhard.
- p. 98. Under Söderman insert Aleksander before Henrik.
Under Solier, line 1, insert *P.* before *Opus. Ent.*
- p. 100. Under Stein, Paul, insert *B.* before *Deutsche* and read 236-241 for 236-237.
- p. 102. Under Szepliget, line 1, insert *Ent. News* before 33.
- p. 103. Read Thieme for Thiene.
- p. 104. Under Trembley read 1710 for date of birth.
- p. 105. Under Tutt insert *P.* before *Ent. Record.*
- p. 106. Under Uzel read 1946 as date of death.
- p. 107. Under Vimmer read 1941 as date of death.
- p. 108. Under Waga, line 2, read *Dict.* for *Diet.*
- p. 109. Under Walton, Lee Barker insert *P.* after H. Osborn.
- p. 110. Under Wattenwyl, insert *P.* before *Ent. Record* and read 1-2 for 5-6.
Under Webster, line 1, insert 96 after 27.
- p. 111. Under Welles add Salter after Charles.
- p. 112. Under Whitehouse insert Harold before Beckwith; read 1883 for 1833.
- p. 113. Under Wilkinson read 1816 for 1805.
Under Williston, line 3, read (4) 47 for (4) 7.
- p. 115. Under Wrangell read 1796 as date of birth.

An Ecological Study of a Minnesota Pond*

Clarence F. Dineen

University of Notre Dame, Notre Dame, Indiana

This paper presents the results of an ecological study of a pond over a period of nearly two years. Seasonal fluctuations in populations, food web dynamics, and community development are given special emphasis. Qualitative and quantitative aspects are considered.

In general quantitative data are scattered and fragmentary with respect to natural ponds. The physical conditions of a pond usually fluctuate so rapidly and to such great extremes that random observations and short-period studies are quite meaningless in the evaluation of pond dynamics. Likewise, diverse chemical conditions of small bodies of water lessen the significance of a single chemical analysis. While many workers have studied the biota of ponds, only a few have made ecological studies. Allee (1911) and Peterson (1926) studied seasonal succession of the biota of ponds. Shelford (1911) investigated pond biota in relation to the age of the ponds. Plankton communities were studied by Eddy (1934). Mozley (1932) made a biological study of a temporary pond in Canada. Recently, Kenk (1949) worked on temporary and permanent ponds in southern Michigan and included a report on the general physico-chemical and biological conditions of temporary ponds.

For many years Europeans reared fishes in ponds for food and recently commercial minnow rearing has become an important industry in some sections of America. Although management of artificial ponds has resulted in extensive research, the data in many respects are not directly applicable to natural ponds.

The pond in the present study is located in a pastured, oak-grove area of Ramsey County, one mile east and 2.5 miles north of the University of Minnesota Agricultural College and Farm in St. Paul. The field work extended from July 1948 to May 1950. Quantitative collections were made weekly except during the winter when monthly collections were considered sufficient. However, whenever pond conditions were changing rapidly, the pond was studied daily.

TOPOGRAPHY AND MORPHOLOGY

The pond is located in a belt of low hills which is part of a Pleistocene glacial moraine. The topography of the original sandy basin of the pond was determined by a series of borings along two transect lines (fig. 1). A large part of this basin was filled by deposition and a small portion (east end) was eliminated by a highway. A natural drainage outlet on the northwestern corner perhaps limited the depth of the original pond in recent time to about seven meters. Some forty years prior to this study, a ditch dug in the outlet, lowered the possible maximum water level nearly two meters but never

* A portion of a thesis submitted to the University of Minnesota in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The author is indebted to Professor Samuel Eddy for direction and encouragement during this study. Aid of the staff of the Minnesota Conservation Department is also acknowledged.

completely drained the pond. At present, surface water from approximately 20 acres of oak-grove pasture and cultivated land drains into the pond.

The depth of the pond during this study varied from .56 M to 1.2 M. The basin slopes very gradually (fig. 1). A maximum area was recorded in April 1949 as 29,799 sq. M (7.33 acres) and a minimum of 7,457 sq. M

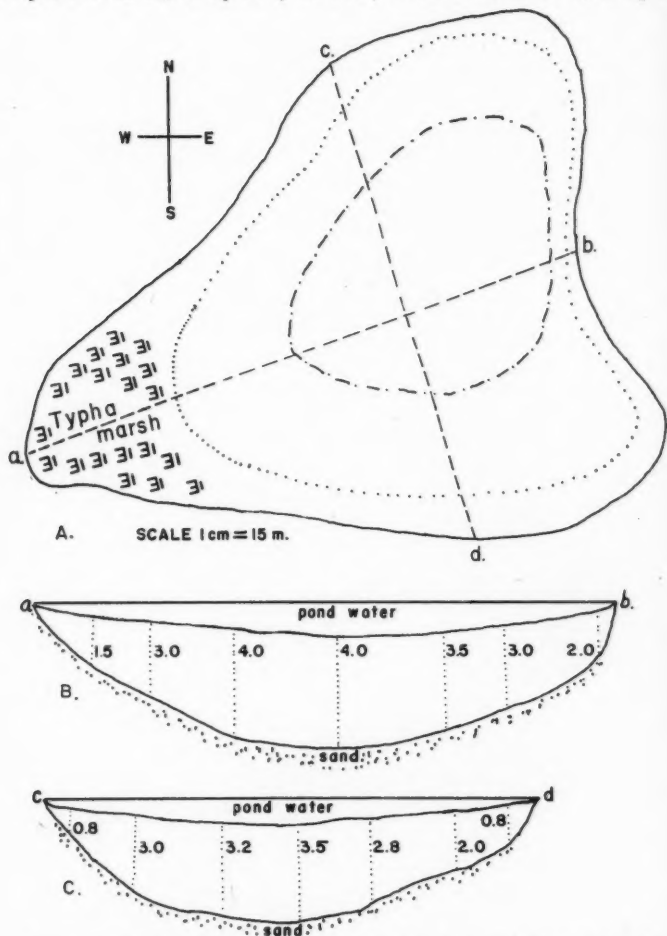


Fig. 1.—A. Surface aspect of the pond. Solid line—high water level; Broken line—low water level; Dotted line—inside margin of emergent vegetation. B, C. Transect profiles of the pond. Maximum depth of bottom deposits expressed in meters. Maximum water depth 120 cm.

(1.84 acres) was reached in October 1948. Throughout most of the summer the area was about 19,000 sq. M (4.7 acres). The length of the shore line during the period of highest water level was 735 M and only 330 M at the time of the lowest level.

BOTTOM DEPOSITS

The depth of the bottom deposits varied from 0.8 M in the outer margin of the emergent plant area to 4 M in the deeper sections (fig. 1). In general the deposits were similar to those in the littoral area of some nearby eutrophic lakes, i.e., a mixture of deposits of allochthonous origin, derived from the land communities, with autochthonous materials—products of the aquatic community dynamics. The Davis borer collections from the lower levels were not analyzed in detail. However, the upper portion (.5 M) of the deposition was examined carefully. These were comparatively uniform throughout the pond; consisting mainly of coarse fibrous fragments of aquatic plants. A No. 40 standard sieve retained approximately 40 per cent of each Ekman dredge collection from shallow water and 30 per cent from the deeper parts of the pond. A part of the plant materials was reduced to sapropel, a black organic sediment which is formed by the action of heterotrophic bacteria under anaerobic conditions. According to Lauterborn (1901) it is often formed in shallow ponds that are rich in rooted aquatic vegetation and duckweed. The present author noted stagnant conditions which resulted in anaerobiosis during the winter and also in summer beneath the mats of algae and duckweed.

The organic ooze of the upper few centimeters of bottom deposits contained coprogenous material. Deposition was most noticeable during the summer of 1948 when chironomid larvae and small oligochaetes were abundant. Also, the exoskeletons of small crustaceans and the cell walls of diatoms were common. Fine sand particles were present in very limited amounts in most of the collections.

PHYSICAL FACTORS

Water level, temperature, wave action, color, and transparency of the pond were recorded whenever collections and/or observations were made. The climatic data were supplemented with weather bureau records for Wold-Chamberlain Airport at Minneapolis, Minnesota (less than 10 miles from the pond).

Water level.—The atmospheric temperature during this study, as recorded by the weather bureau, did not vary greatly from the normal, but the total precipitation in 1948 was 10.75 inches below normal. This was a deficiency of over one third of the normal precipitation. The deficiency in 1949 was 2.52 inches. Also, the snow cover on the pond was much less in the winter of 1948-49 than in the following winter. Only 5 cm of snow covered the ice during the coldest days in January 1949.

A permanent water gauge was used to determine the maximum and minimum water level for each month (table 1). The deficiency in rainfall resulted in a low water level of 56 cm in October and December 1948. Many other shallow ponds in the area were dry during the fall of this year. The total depth (water and ice) of the pond was 60 cm in January and February of 1949 and 1950; the water was frozen to the bottom in 1949 whereas only

44 cm of ice was formed in 1950. The difference was due to the absence of heavy snow during the first winter and low temperatures in January 1949. Consequently, the dynamics of the pond community were greatly altered by the winter conditions. Following the spring thaws in 1949 and 1950, the water level was limited to 110 cm by the drainage ditch; and for a short period in August 1949 the relatively abundant vegetation in this ditch maintained a level of 120 cm in the pond.

TABLE 1.—Monthly maximum and minimum water levels (cm)

	1948		1949		1950	
	Max.	Min.	Max.	Min.	Max.	Min.
Jan.			60 (60)*	60 (60)	60 (30)*	60 (30)
Feb.			60 (60)	60 (60)	60 (44)	60 (44)
Mar.			60 (60)	60 (60)	110 (47)	110 (47)
Apr.			110	110	110	110
May			110	95		
Jun.			94	85		
Jul. 88	78		117	95		
Aug. 95	82		120	115		
Sep. 78	69		114	106		
Oct. 56	56		109	102		
Nov. 58	58		90	90		
Dec. 56 (20)*	56 (20)		70 (10)	70 (10)		

* Numbers in parentheses indicate the depths to which the pond was frozen.

Temperature.—The surface temperature of the pond water ranged from 0° C to 29° C. The summer daily temperature fluctuated rapidly with changes in air temperature. The variation in temperature from the surface to the bottom of the pond was usually less than 1.5° C. However, when the air temperature increased rapidly and the pond remained calm for several days, greater thermal stratification was evident. On July 10, 1948 the following temperatures (°C) were recorded: air—29, surface water—28.5, 10 cm depth—26, 30 cm depth—24, 50 cm depth—24.

In winter, thermal stratification in the bottom deposits was indicated by the following temperatures in January 1949: 1°C—5cm, 4+°C—40 cm, 6°C—60 cm, 8+°C—80 cm.

There was always a considerable lag in the temperature changes in the bottom sediments as compared to the temperature fluctuations in the water. The lag was very pronounced in the fall and spring (table 2).

Although most pond organisms have a wide tolerance to changes in temperature, the size of the populations, the habits, and development of many organisms were correlated with changes in temperature. Ward (1940) concluded that species and population density of entomostracans in a series of ponds in Ohio were related to seasonal temperatures.

Wave action.—The pond was partly sheltered by trees and low hills which usually limited wave action to ripples sufficient to prevent the duckweed from dispersing over the central two thirds of the pond. In summer, particularly when aquatic plants were at maximum growth, the pond sometimes remained calm for several days. On a few occasions the wind produced waves which reached a maximum of 15 centimeters.

TABLE 2.—Temperature changes (°C)

	Bottom Deposits (15 cm deep)	Water (15 cm deep)		Bottom Deposits (15 cm deep)	Water (15 cm deep)
Sep 11, 1948	24	24	Apr 9, 1949	2	7
Sep 18	22	23	Apr 13	2+	11.5
Sep 25	16	16	May 7	10	16
Oct 2	16	14	May 14	10	17
Oct 12	13	11	May 26	14	19
Oct 23	9	11	May 30	20	25
Nov 13	5	0	Jun. 4	20	21
Dec 18	1+	0—	Jun. 20	24	28+

Color and transparency.—Due to the organic nature of the bottom deposits, the water appeared brownish during most of the year. The heavy algal blooms in summer produced an apparent bluish-green color and during the winter anaerobic period the water appeared bluish-black.

In the open-water area, light usually penetrated to the bottom. Species of *Spirogyra*, *Oscillatoria*, and *Oedogonium* grew near the bottom at all depths and *Potamogeton berchtoldi* flourished in the deeper area. However, floating mats of Lemnaceae and *Hydrodictyon* often prevented light from penetrating the water. These mats were extensive in the shallow area during the summer and fall and plants and animals were very scant beneath them. Likewise, thick ice and snow in the winter reduced light penetration.

CHEMICAL FACTORS

Chemical analyses were limited largely to routine determinations of dissolved oxygen, pH, free carbon dioxide, monocarbonates, and bicarbonates. Total dissolved solids were determined for the spring, summer, and fall of 1949. With the aid of the members of the Minnesota Conservation Department, fairly complete chemical analyses were made for August and September of 1948. Also, daily fluctuations and variations within the pond were measured on several occasions.

All water samples for routine chemical analyses (table 3) were taken at 10 A. M. at a permanent centrally located station. The methods were in accordance with the 9th edition (1946) of *Standard Methods for Examination of Water and Sewage*.

TABLE 3.—Routine chemical analyses

	Water Temp. °C	Dissolved Oxygen ppm	Per cent Sat.	Free CO ₂ ppm	Mono- carb. ppm	Bi- carb. ppm	pH
Jul 1948							
10	26	11.0	134	1.8	0	55	7.6
17	26	9.1	111	3.0	0	65	7.3
24	26	8.2	100	1.5	0	47.5	7.3
31	26	6.6	80	5.0	0	42.5	7.0
Aug							
7	25	5.6	66	6.0	0	55	7.0
13	29	10.0	129	0.0	trace	50	7.9
21	28	5.0	63	8.0	0	57.5	7.1
28	25	2.7	32	7.0	0	65.5	7.0

TABLE 3.—(continued)

	Water Temp. °C	Dissolved Oxygen ppm	Per cent Sat.	Free CO ₂ ppm	Mono- carb. ppm	Bi- carb. ppm	pH
Sep							
7	24	12.0	141	4	0	60	8.0
11	24	16.0	188	0	15	57.5	8.2
18	23	9.0	103	0	5	50	8.2
25	16	13.0	130	0	10	45.5	8.3
Oct.							
2	14	8.0	78	0	10	50	8.3
12	11	12.1	111	0	15	35	8.3
23	10	12.4	109	0	12.5	35	8.4
30	8	9.0	75	0	5	45	8.4
Nov.							
13	5	6.8	53	0	8	52.2	6.0
Dec.							
17	1	8	56	0	10	67.5	8.0
Apr 1949							
9	7	3.5	28	10	0	36	6.6
23	10	10.0	88	0	7	27	8.0
30	15	7.0	70	0.5	0	36.5	6.8
May							
7	16	2.7	27	18	0	46	6.8
14	17	7.1	73	5	0	49	7.0
26	19	10.0	111	0	2	45	7.7
30	25	9.4	112	0	2.5	44	8.2
Jun.							
4	21	6.2	68	4	0	50	7.2
20	27	15.0	182	0	22	54	8.8
25	27	10.0	120	0	9.5	55	9.4
Jul.							
1	27	12.0	146	0	23	54	9.0
9	26	8.0	98	0	12	51	9.1
16	26	8.3	101	0	6	61	9.2
23	25	11.2	133	0	15.5	50	9.4
30	22	0.6	7	28	0	58	6.8
Aug.							
3	23	6.6	75	10	0	59	7.0
6	25	4.4	32	9	0	60	7.0
13	25	1.3	15	5	0	63.5	6.7
20	22	5.3	54	trace	0	65.7	6.8
Sep.							
3	20	6.6	72	0.5	0	65	7.3
15	18	9.6	101	trace	0	64	8.0
24	15	7.3	72	trace	0	67	7.8
Oct.							
8	13	8.0	75	0	7	60	8.6
28	10	12.0	106	0	10	58	8.2
Nov.							
18	8	10	84	0	10	63	8.2
Dec.							
2	1	8	56	0	8	60	8.2
Jan. 1950							
28	0	0	—	90	0	275	6.4

Oxygen.—Dissolved oxygen in the pond water fluctuated rapidly and to extremes. The range was from zero to 16.0 ppm (188 per cent saturation) according to the unmodified Winkler technique.

The oxygen supply was correlated with growth and decomposition of chlorophyll-bearing plants; namely, *Hydrodictyon reticulatum*, *Aphanizomenon flos-aquae*, *Spirogyra* spp., and *Potamogeton berchtoldi* (= *P. pusillus* Fassett). During periods of heavy growth of green plants, the amount of dissolved oxygen commonly varied from 1 or 2 ppm at sunrise to 10 to 15 ppm (supersaturation) in midafternoon. When large algal blooms "died off" in mass, the changes in supply of dissolved oxygen, the free carbon dioxide content, and pH were significant. When a mass of *Hydrodictyon* began to decompose on July 23, 1949, the oxygen content was 11.2 ppm (133% sat.). On the morning of July 30, the oxygen supply was 0.6 ppm (7% sat.) in most of the pond. Afternoon determinations of oxygen were equally low. The bulk of decomposition was completed by August 3rd, and the oxygen content in the center of the pond was 6.6 ppm (75% sat.), however, adjacent to remaining decomposing mats, which were blown against the marginal vegetation, the oxygen measured only 3.6 ppm (40% sat.). Similar changes have been reported by Mackenthun and co-workers (1945), Moore (1942), and Barney and Anson (1920). Oosting (1933) also reported tremendous variation in dissolved oxygen in the northwest area of Ham Lake, Minnesota. The chemical and physical conditions of the littoral area described by Oosting were comparable to pond conditions in many respects.

Wave action on extremely windy days was a major factor in producing a high oxygen content—10 ppm, 129% sat. on August 13, 1948 and 10 ppm, 88% sat. on April 23, 1949 exemplify conditions caused by wind disturbances.

Free carbon dioxide and total alkalinity.—The free carbon dioxide content of the water varied greatly (table 3). In summer very little free carbon dioxide was present during daylight except when algal blooms were decomposing. On July 30, 1949, when large mats of dead algae covered much of the pond, the free CO₂ content was 28 ppm. Also, during the winter when the snow and ice excluded most of the light, the CO₂ content increased greatly (table 3).

Hydrogen ion concentration.—The pH of the water, as indicated by the routine, morning analyses, ranged from 6.2 to 9.4 (table 3). However, the pH often varied from one section of the pond to another and diurnal fluctuations were common (i.e., Sept. 24, 1949—pH 7.5 at 6 a.m. and 8.5 at 3 p.m.). The great fluctuation of pH during the day and night and the differences within the same body of water at any set time, were studied in detail by Cowles and Schmittalla (1923) and Philip (1927). Philip concluded that the prevalent practice of making one determination for a particular day or period in the year was not an accurate index of the true hydrogen ion activity in an aquatic community. The pH of the pond in the present study was not considered a valuable index of pond conditions.

Additional chemical analyses.—In the summer of 1948 members of the Minnesota Conservation Department aided the author in making two general chemical analyses (table 4).

Moyle (1946) reported a range of 0.1 to 2.0 ppm for summer nitrogen

TABLE 4.—Chemical analyses

	Jul. 21, 1948 ppm	Aug. 25, 1948 ppm
Sulphate ion	0.3	0.0
Soluble phosphorus	0.3168	0.48
Organic phosphorus	0.0782	0.24
Total phosphorus	0.396	0.72
Chloride ion	9.8	8.28
Ammonia nitrogen	0.099	0.3
Nitrite nitrogen	0.0	0.02
Nitrate nitrogen	0.108	0.25
Organic nitrogen	0.0398	0.6
Total nitrogen	0.2468	1.17
Total alkalinity	60.0	53.75

in the natural surface waters of Minnesota, and sixty-five fish ponds had an average of 1.002 ppm. The summer phosphorus content in the present pond was high when compared to average figures of 0.005 to 0.2 ppm for ponds and lakes in Minnesota (Moyle, 1946). The high phosphorus concentration was associated with heavy algal blooms.

The decantation method was used to determine total dissolved solids. The organic was considerably greater than the inorganic content (table 5).

TABLE 5.—Total dissolved solids

Date	Total Dry Residue mg/L	Dissolved Organic Matter mg/L	Ash mg/L
Apr. 1949	200.2	108.2	92.0
Jun. 1949	386.6	201.3	185.3
Aug. 1949	502.4	311.6	190.8

THE POND AS AN AQUATIC COMMUNITY

Larger aquatic plants.—Abundant growth of emergent plant formed a peripheral girdle varying in width from two meters to 30 meters (fig. 2). The most abundant species were: *Sagittaria latifolia* Willd., *Typha latifolia* Linn., *Acorus calamus* Linn., *Eleocharis palustris* (Linn.), *Glyceria grandis* Wats., *Leersia oryzoides* (Linn.), and *Phalaris arundinacea* Linn.

There were no rooted floating-leaf hydrophytes; *Potamogeton berchtoldi* was the only species of rooted submerged pondweed.

The standing crop of the rooted aquatic vegetation in the water was measured in August 1948, when the water margin of the pond was just inside the major mass of peripheral, emergent plants (fig. 1). It was measured for this same area again in August 1949 which was the period of maximum growth. A white metal quadrat (sq. M) was used to collect representative samples. In the laboratory each species was dried in an oven at 60° C for 72 hours and then weighed. A representative sample of each species was ashed at 600° C for three hours. The average ash content of rooted aquatic plants was 3 per cent of the dry weight. The total weights are given in table 12.

Duckweed and certain species of filamentous algae.—Three species of

Lemnaceae grew in the pond. *Spirodela polyrhiza* (Linn.), the greater duckweed, was predominant, representing approximately 90 per cent of all the duckweed in the pond. The remaining portion was largely the lesser duckweed, *Lemna minor* Linn. A few star duckweed plants, *Lemna trisulca* Linn. inhabited the water under the cover formed by *Hydrodictyon* and the other two species of duckweed. Duckweed was common in the shallow, quiet water from early July until late October. The distribution in the pond was limited by wind action and the emergent plants. These small plants were often blown several layers deep among the emergent plants and died after a short time due to insufficient light. In summer the blanket of duckweed extended from the emergent plants inward for a distance of one to 10 meters depending upon various physical conditions and the rate of vegetative reproduction. Flowering and seed formation were not observed. Turion formation (modified non-buoyant, dormant stage) was noted from July until October.

Hydrodictyon reticulatum (Linn.) *Spirogyra* spp. and to a much lesser extent *Oedogonium* spp. and *Oscillatoria* spp. constituted an important group of producers in the pond. These filamentous algae were not considered true plankters because they were associated with the bottom, rooted aquatic plants, and in the case of *H. reticulatum* with the surface water. *H. reticulatum* was very abundant during the summer. It occurred at all water levels but as the nets grew larger they accumulated near the surface, forming a dense mat. In the summer of 1948 the vegetative mass never decomposed rapidly. However, in late July 1949 a prodigious quantity was produced which formed a heavy mat over approximately one third of the pond (fig. 2). The bulk of this tremendous growth "died off" during the last week of July, producing significant biotic and chemical changes.

The growth of *Spirogyra* was abundant in late summer and fall. It was common only in the shallow water and was closely associated with the bottom of the pond. Quantitative measurements were not possible because the masses of *Spirogyra* could not be separated from the bottom materials. Also, some of the living filaments could not be distinguished from non-living filaments as



Fig. 2.—Summer aspect of the pond. Note mat of duckweed and algae in the foreground. July 16, 1949.

all degrees of decomposition existed. The lower parts of these masses contained only dead filaments and debris while the upper parts continued to grow and reproduce rapidly.

The ash-free dry weight of the surface mat of *Hydrodictyon* and species of Lemnaceae during the first week of August 1948 and the last week of July 1949 are given in table 12.

Plankton.—The major groups of plankters were algae, copepods, cladocerans, and rotifers. A few ostracods were collected. Also, there were numerous bacteria living in the open water as true plankters; a study of these is not included.

Methods.—Four quantitative net-plankton collections were made weekly except when ice was on the pond (total—188 collections). A No. 25 bolting silk net was used to concentrate the organisms from 100 liters of water for each collection. Two permanent collecting stations were used and care was taken to include water from all levels and to avoid contamination. A rubber, one-man boat was used to reach the open-water area and to avoid disturbance. In order to insure representative sampling, additional collections were taken when floating mats of vegetation were extensive and also when the pond was disturbed (winds and rain). The organisms were counted with the aid of a compound microscope, Sedgewick-Rafter cell and a Whipple square. The ash-free dry weight of the net-seston (total suspended matter collected per unit volume) was determined for each month by grouping representative weekly collections, drying them in an oven at 60° C, weighing, ashing for 3 hours at 600° C, and reweighing (table 6).

Water samples (4 liters each) were collected for nanoplankton studies (total—47 collections). The plankters were separated from the water by decanting. Counts and seston weights were determined (table 6). These seston weights were correspondingly greater than the net-seston weights because many of the small plankters, particularly the unicellular algae, Protozoa, and the fine detritus suspended in the pond water were not retained by the standard net.

TABLE 6.—Seston, ash-free, dry weights (mg/L)

	1948		1949	
	Net Seston	Water Sample Seston	Net Seston	Water Sample Seston
Apr.	—	—	.281	.751
May	—	—	1.226	2.258
Jun.	—	—	2.665	7.830
Jul.	3.442	5.432	3.121	5.875
Aug.	2.966	4.793	2.727	5.606
Sep.	2.565	4.304	3.156	6.093
Oct.	1.004	2.601	2.531	5.406
Nov.	.953	2.113	1.213	3.114
Dec.	1.211	3.121	1.651	3.060
			Jan. 1950	1.511
				3.364

Seasonal populations.—The seasonal populations of plankters varied greatly with respect to numbers of species and individuals. Sometimes the fluctuations were rapid and extremely great. The plankton formed a very important

portion of the complete food web. Species of Myxophyceae, Bacillariaceae, Chlorophyceae, and chlorophyll-bearing flagellates were classified as producers while the Copepoda, Cladocera, and Rotatoria were primary consumers.

TABLE 7.—Average monthly collections of plankton (no. per liter)*

	Myxophyceae	Bacillariaceae	Chlorophyceae	Cladocera	Copepoda	Rotatoria	Protozoa
Jul. 1948	2,796	35	380	68	513	393	3,156
Aug.	730	1	591	722	343	4,177	3,310
Sep.	8,608	125	129	771	42	363	167
Oct.	197	744	290	225	73	61	30
Nov.	340	2,104	1,246	153	38	77	23
Dec.	692	3,574	3,202	21	49	129	3
Apr. 1949	261	173	13	4	601	5	52
May	4,067	8	161	62	217	108	24
Jun.	1,749,216	0	84	165	832	1,284	1,108
Jul.	6,462	1,102	65	28	573	972	2,364
Aug.	3,334	150	3	342	638	1,761	16,847
Sep.	50,729	2,478	112	563	127	183	252
Oct.	208,433	2,802	98	14	46	170	158
Nov.	10,451	2,124	81	13	29	716	126
Dec.	4,552	3,972	110	8	25	966	185
Jan. 1950	1,328	16,321	913	0	0	270	40

* In the following genera, colonies or trichomes were counted instead of cells: Myxophyceae—trichomes, *Aphanizomenon*, and *Gloeotrichia* colonies, *Aphanocapsa* and *Microcystis*. Chlorophyceae—colonies, *Nephrocytium*, *Pediastrum* and *Tetraspora*.

Blue-green algae were predominant (table 7). In June, September and October of 1949 tremendous "blooms" of *Aphanizomenon flos-aquae* were produced (maximum of over 1.5 million trichomes per liter in June). Species of *Microcystis*, *Anabaena*, and *Oscillatoria* were common. *Merismopedia*, *Aphanocapsa*, and *Gloeotrichia* were collected infrequently.

With the exception of *Fragilaria*, a few species of *Navicula*, and an occasional *Surirella*, the diatom population was very meager. This population increased greatly during the colder months (table 7). Temperature and free carbon dioxide may have been controlling factors.

Hydrodictyon reticulatum, *Spirogyra* spp. and *Oedogonium* spp. were not included in the plankton counts of Chlorophyceae. The role of these algae in the pond community is discussed on p. 356. Seventeen other genera of green algae were collected, but no one genus was collected in great abundance. *Cosmarium*, *Pediastrum*, *Scenedesmus*, and *Staurastrum* were found in most of the collections throughout the year. *Chaetophora*, *Closterium*, *Coelastrum*, *Desmidium*, *Euastrum*, *Kirchneriella*, *Micrasterias*, *Nephrocytium*, *Pleurotaenium*, *Selenastrum*, *Spondylosium*, *Tetraspora*, and *Xanthidium* were found occasionally. The total population of planktonic green algae was much greater

in 1948 than in 1949 (table 7). The "blooms" of *Aphanizomenon* in 1949 may have been detrimental to the growth of many green algae.

The green flagellates (Phytomonadina) were abundant during the summer and fall. The largest populations of *Volvox* appeared in July 1948 (2079 per L) and in August 1949 (5362 per L). *Pleodorina illinoisensis* reached a population density of 3090 per L in August 1948 whereas *Eudorina elegans* numbered less than 50 per L. In August 1949 the ratio of the latter two species was reversed. *E. elegans* reached a population peak of 3463 per L and *P. illinoisensis* was sparse (10 per L). Likewise, the ratio of *Volvox* species varied considerably from one year to the next. *Synura uvella* and *Pandorina morum* was collected in small numbers during the summer of 1948. *Phacus longicaudus*, *P. pleuronectes* and *Trachelmonas* were minor constituents of the plankton. The common lake plankter, *Ceratium hirundinella*, was present in most of the 1949 collections with a population peak of 7860 per L in August. Large clusters of *Vorticella* were commonly attached to the antennae and body of copepods and cladocerans, suggesting a biotic control.

Most of the 29 species of rotifers collected in the pond were seasonal. The maximum population was reached in August (4177 per L and 1762 per L in 1948 and 1949, respectively). *Keratella cochlearis* and *K. quadrata* were predominant winter species, however, the maximum population of each species occurred during the summer months. The six species of *Brachionus* (*angularis*, *calyciflorus*, *capsuliflorus*, *furcatus*, *havanaensis*, and *urceus*) were summer inhabitants of the plankton. *Asplanchna brightwelli* (maximum 238 per L) was restricted to the month of August. The colonial rotifer, *Conochiloides* was very abundant in August 1948 (1249 per L) but it occurred rarely in the other collections. *Euchlaris dilatata*, *Platytas patulus*, *Filinia longiseta*, and *Conochilus* were other common rotifers. *Coleurella* sp., *Diurella brachyura*, *D. tigris*, *Lecane luna*, *L. ohioensis*, *Monostyla quadridentata*, *Mytillina spinigera*, *Pedalia mira*, *Platytas quadricornis*, *Polyarthra trigla*, *Rotaria neptunia*, *Synthaeta* sp., *Testudinella* sp., *Trichocerca cylindricus*, and *Trichocerca gracilis* were collected in small numbers.

Bosmina longirostris was the predominant cladoceran throughout the year—reaching a maximum population in late summer (763 per L). *Chydorus sphaericus* was collected consistently but never in great numbers (maximum 19 per L). Seven other species (*Alona costata*, *Ceriodaphnia quadrangula*, *Daphnia longispina*, *D. pulex*, *Diaphanosoma brachyurum*, *Macrothrix rosea* and *Scapholeberis mucronata*) were largely summer residents in the plankton. *Macrothrix rosea* was associated with pondweed.

Three species of copepods, *Diaptomus eiseni*, *Cyclops bicuspidatus thomasi*, and *Canthocamptus staphylinoides*, were common plankters. *D. eiseni* reached a population peak of 82 per L in August 1949. This species is commonly found in ponds in central Minnesota but the author also has found numerous specimens in plankton from lakes in Canada. *C. bicuspidatus* showed two definite seasonal population maxima. The first of these appeared in April (190 per L) and a second was reached in July and August (201 per L). Frequent collections indicated that population peaks of nauplii preceded those of the adults by about 10 days. *C. bicuspidatus thomasi* was taken in

all plankton collections except in January 1949 when the water was only 20 cm deep. Encysted individuals were found in bottom deposits, however, this "resting stage" did not always appear to be a part of the life history. In July the complete population apparently excysted. However, many cysts were collected during the early summer months when the water was saturated with oxygen and the temperature was above 20° C. Birge and Juday (1908) reported that summer populations in some lakes remained active with no encystment. Environmental factors which may induce encystment and excystment were obscure. The life cycle of this same organism was different in Crystal Lake, Minnesota as reported by Cole (1953). The vast majority of cysts were collected in the upper few centimeters of the flocculent ooze. The planktonic population of *Canthocamptus staphylinoides* in the pond was monocyctic. A population of 17 per L was collected in April with a standard net. The entire population reproduced and disappeared from the plankton within a month. The young matured, encysted and remained inactive until winter when some of them excysted and became active in the bottom ooze. By April, the entire population had excysted, matured and attained more or less planktonic habits. The cysts of *C. staphylinoides* were difficult to find because of a heavy coat of detritus which adhered firmly to the outer wall. Cysts were found as deep as 20 cm in the bottom deposits, however, core samples indicated that the majority of these remained in the upper 2 or 3 cm of ooze. The outer wall of the cysts was only about two thirds as thick as the cyst wall illustrated by Lauterborn and Wolf (1909) for *C. microstaphytinus*.

Fishes.—Fishes were the top predators in the pond until eliminated by severe winter conditions in the early months of 1949. During the summer and fall of 1948, quantitative collections could not be made because the soft, organic bottom and masses of pondweed and filamentous algae made seining ineffective. Qualitative collections were made in order to determine the species of fishes and to analyze stomach contents. The small green sunfish (*Lepomis cyanellus* Raf.) was the most common fish in the pond. The fathead minnow (*Pimephales promelas* (Raf.)) ranked second. A few brook sticklebacks, *Eucalia inconstans* (Kirtland) also were collected.

Small leeches and various immature insects were eaten in large numbers by the green sunfish. *Glossiphonia stagnalis* was a major food item of this centrarchid. The digestive tracts of the fathead minnows contained both plant and animal materials; filamentous algae were consumed frequently in large amounts. The stickleback is considered carnivorous.

Breeding habits of the fathead minnow were observed during the summer of 1948. In July a number of markers (flooring material 1-3 inches wide) were placed in a vertical position to indicate depths, collecting stations, etc. in the pond. Many egg masses of the fathead minnows were deposited on the markers during the last week of July and early August. Deposition of eggs on vertical objects is rather unusual for this minnow. Markus (1934) reported that this minnow normally deposits its eggs on the under side of objects that lie horizontal to or at an angle with the surface of the water. Rocks, timber, and concrete, which afforded sufficient space underneath the object for activity of the male, were common nesting sites. Doubtless the

lack of such nesting sites in the pond was responsible for deposition of eggs on the vertical markers. Egg masses of the fathead minnow contained from 25 to 200 eggs and invariably arranged in a single layer. The average time from the appearance of eggs until hatching was nine days. The eggs were guarded by the male.

During the winter of 1948-49 the pond froze to several centimeters of bottom ooze even in the deepest section of the pond. The low water level (60 cm), low temperatures, and an absence of snow were the major factors



Fig. 3.—April 10, 1950. Floating mat of ice and frozen bottom materials. During the spring of 1949 practically the entire pond surface was in this condition for more than a week.

producing a thick layer of ice. This frozen mass was a limiting factor for many organisms and a few, including the fishes, were eliminated, apparently by suffocation. Following the spring thaw several hundred fishes were collected and examined. An exact count of the total population of these (perhaps several thousand) was not possible. Sections of the pond did not thaw at the same time, thus the dead fishes were released at intervals for a period of approximately two weeks. The majority of the small fishes were entangled in masses of vegetation and buried in the ooze bottom. The floating masses of ice and bottom deposits (fig. 3) also prevented an exact count.

A representative collection along the margin of the pond included the following: 202 green sunfish (*Lepomis cyanellus*), 100 fathead minnows (*Pimephales promelas*), 12 brook sticklebacks (*Eucalia inconstans*).

TABLE 8.—Dead green sunfish recovered

Number	Standard Length (cm)	Total Wet Wt. (g)
2	12.14	116.3
55	7.8	635.5
145	4.5	246.5

The green sunfish were divided into three age groups according to standard length (table 8).

The scales of the large sunfish indicated an age of three years. The fat-head minnows averaged 6 cm (standard length). The total weight (wet) was 240 g. The standard length of the 12 brook sticklebacks ranged from 4.6 cm; total wet weight—10.8 g.

Bottom fauna.—Because the entire pond was a littoral area less than 1.2 M deep, it was possible to observe many of the bottom organisms in their natural habitats and adequate samples were collected without great difficulty. The bottom fauna was divided into four major groups on the basis of food habits, namely, browsers, swimming predators, plankton predators, and benthic predators (table 9).

TABLE 9.—Check list of bottom fauna according to food habits

SWIMMING PREDATORS	PLANKTON PREDATORS	BROWSERS
<i>Erpobdella punctata</i>	<i>Plea striola</i>	Oligochaeta
<i>Macrobdella decora</i>	Chaoboridae	Gastropoda
Hydracarina		<i>Hyalella</i>
Belostomatidae	BENTHIC PREDATORS	Ephemeroptera
<i>Notonectus</i>	<i>Glossiphonia complanata</i>	Corixidae
Dytiscidae	<i>G. fusca</i>	Gyrinidae
	<i>G. stagnalis</i>	Haliplidae
	Odonata	Hydrophilidae
	Ceratopogonidae	Trichoptera
		Chironomidae

Methods.—Quantitative collections of benthic organisms were made at weekly intervals during the summer, and monthly during the winter (185 collections). These collections were taken from two general areas of the pond and additional collections from other sections of the pond were taken frequently as a check to assure adequate sampling. The Birge-Ekman dredge (15 x 15 cm) was used to collect bottom organisms. The dredge collections were sifted in the water using a standard wire sieve (No. 40; openings, 420 microns). In the laboratory the organisms were separated from debris by washing the samples in a white pan. The organisms were identified and counted (table 10). Collections of species for each month were dried in an oven at 60° C and weighed. Then the organisms were ashed for 3 hours at 600° C and reweighed.

Seasonal populations.—Eight species of leeches inhabited the pond. *Glossiphonia stagnalis*, a benthic predator, was predominant. The population ranged from 144 specimens per sq. M in January 1949 to 4135 in October 1949 (fig. 4). In January 1949 when the pond froze to the bottom, eliminating the fishes and reducing some invertebrate populations, striking alterations in the dynamic balance of organisms resulted during the subsequent seasons. The population of the snail leech (*Glossiphonia stagnalis*) was influenced because this organism was a major food item of the sunfish in 1948, particularly during the spring when many insects emerged. Due to the fact that eggs of the *G. stagnalis* are retained in mucoid sacs attached to the ventral surface of the parent where the young also remain attached for a considerable time after

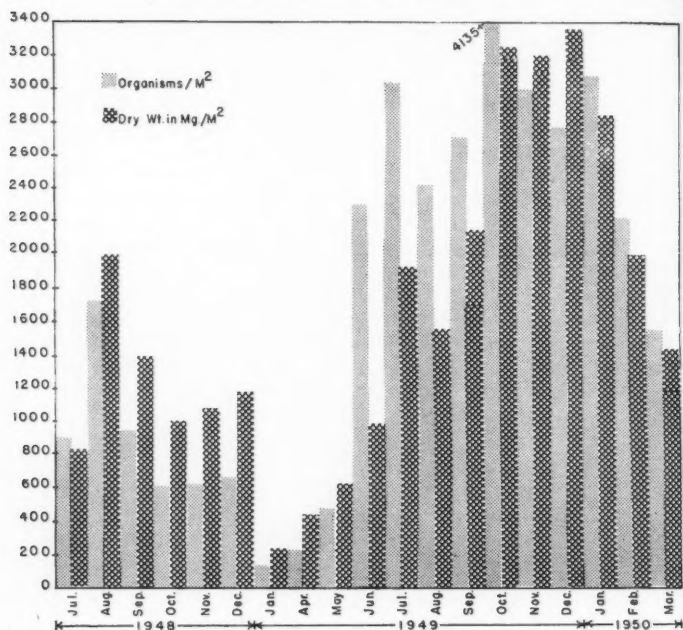
Fig. 4.—Seasonal populations of *Glossiphonia stagnalis* (Linnaeus).

TABLE 10.—Average monthly collections of bottom fauna (No. per sq M)

	Swimming	Predators Plankton	Benthic	Browsers
Jul. 1948	94	25	954	3537
Aug.	66	14	1861	1624
Sep.	61	0	1020	1048
Oct.	67	72	760	4368
Nov.	78	100	888	2985
Dec.	69	133	1160	1592
Jan. 1949	162	133	733	1988
Apr.	38	38	261	439
May	9	7	512	215
Jun.	133	15	2338	668
Jul.	131	13	3055	408
Aug.	110	16	2440	56
Sep.	126	14	2731	332
Oct.	101	28	4163	1333
Nov.	78	122	3011	700
Dec.	34	367	2795	333
Jan. 1950	102	166	3100	1011
Feb.	55	163	2244	1200
Mar.	70	986	1615	1711

hatching, the population of this leech was controlled more effectively by the predation of fishes than in the case of other leeches that deposit their eggs free from the body. Obviously consumption of snail leeches carrying eggs or young, resulted in wholesale decimation of the population. Consequently, when the fishes were eliminated during the early winter months of 1949, an important biotic control of the predominant benthic predator (*G. stagnalis*) was removed. The tremendous biotic potential of the snail leech, when not counteracted by the environmental resistance of fish predation, resulted in an exceedingly large leech population (fig. 4). As a result, many of the food organisms of the snail leech were greatly reduced in number and some were eliminated during the summer and fall of 1949.

The first eggs of *G. stagnalis* were observed in April and by May almost every individual carried eggs or young. The average number of young per parent leech was 12. A few individuals reproduced in June and July with an average of 16 per parent (range 10-20). Another reproductive pulse was noted in the early fall. During this period fewer individuals reproduced and the number of young per parent averaged only 8.

In addition to the number of individuals, the weight of the various populations indicated reproductive periods, growth and food conditions. The June 1949 population consisted of many young leeches and the weight per individual averaged 0.43 milligrams (fig. 4). The average weight per individual in July showed an increase to 0.63 milligrams, indicating growth. It is also significant that the weight per individual during the winter of 1948-49 was much greater than that of the subsequent winter 1949-50, indicating possible submarginal food conditions during the second year. *G. stagnalis* appeared to be very inactive during the winter and probably consumed little food.

The genus *Glossiphonia* was represented in the pond community by two other species. A single individual of *G. fusca* was collected and *G. complanata* was taken in small numbers in 1948 and reached a maximum population of 33 per sq. M in June 1949.

Second in number only to *G. stagnalis*, *Erpobdella punctata*, a swimming predator, was an important pond leech. The largest individual measured 8.8 cm in length. The population varied from a low 9 per sq. M to a maximum of 80. During the winter *E. punctata* concentrated to a certain extent in deeper water. Reproduction occurred in the spring and summer; but a few very young individuals were collected in the fall. The weights indicated submarginal food supply following the winter kill of fishes.

Four large leeches, *Haemopsis grandis* (Verrill), *H. marmoratis* (Say), *Macrobdella decora* (Say), and *Placobdella rugosa* (Verrill) were found on a few occasions.

The majority of oligochaetes were small species of the family Naididae. A population peak of 1260 per sq. M was observed in July 1948. This population diminished rapidly in August and September and reached a minimum in the winter. The weight per individual increased gradually during this period. The spring and early summer collections in 1949 suggested a population curve similar to that of the preceding year (fig. 5), however, the June (1949) population was accompanied by a reproductive phase of the snail leech population. The change in the population of leeches played a domi-

nant role in reducing to almost zero the number of small oligochaetes during the succeeding months. The larger oligochaetes, which were not directly related to the snail leech in the food web, were more common in the summer of 1949 than in 1948.

The amphipod, *Hyalella azteca* (Saussure), primarily a fall and winter inhabitant, reproduced largely during the colder months. Bovee (1949) reported that 33° C is lethal to *Hyalella*, if maintained for a number of hours. The common summer temperature of 24° C in the pond was perhaps beyond optimum temperature for *Hyalella*. The large population during October and November 1949 was associated with luxuriant growth of *Spirogyra* upon which this species feeds. During the winter *Hyalella* was found in masses of partially decomposed *Spirogyra*. A small population in 1948 was correlated with the presence of a predacious fish population.

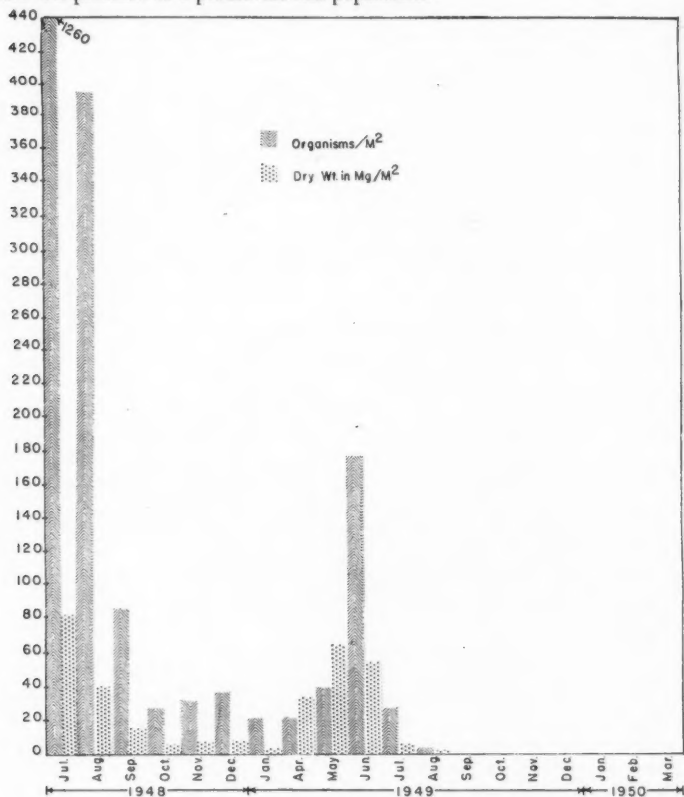


Fig. 5.—Seasonal populations of Naididae (Oligochaeta).

During the summer of 1948 small populations of *Gyraulus parvus* Say, and *Menetus exacuus* Dall, browsed on pondweed and filamentous algae. In late summer and fall numerous snails of the genus *Physa* browsed (maximum population over 100 per sq. M) on the organic bottom and vegetation. *Menetus* and *Gyraulus* did not move to deeper water nor burrow in the ooze for protection during the winter. Numerous individuals, together with masses of filamentous algae, were frozen in the ice and ooze. A considerable number of *Physa* also were frozen and many other individuals apparently were winter-killed by the stagnant conditions as indicated by numerous dead specimens along the shore following the spring thaw in 1949. Not a single living *Physa* was collected during the remaining period of this study. Apparently, the winterkill was complete or the population was reduced to such a low level that the young were eliminated by predators. Likewise, the small snails, *Menetus* and *Gyraulus*, were conspicuously absent after July 1949; no doubt a favorite prey of the snail leeches. *Helisoma trivolvis* Say, was collected occasionally during the summers.

Chironomus was the predominant genus of dipterans. In July 1948 very small larvae were abundant (1600 + per sq. M, fig. 6). This population of browsers was reduced to about one half during August and September. Predation and emergence were two contributing factors. A maximum weight per individual was reached in September. A fall reproductive period increased the total population of chironomids to a total of approximately 3200 individuals per sq. M. By early April 1949 the population was reduced to only 350 per sq. M. This population emerged in the latter part of April and in May. The population curve showed an expected increase in number of young in June, however, in July the small individuals became scarce and only a very few were collected during the remaining period of this study. Predation was the major factor in reducing the number of chironomids. The family Ceratopogonidae was represented by one genus, *Palpomyia*. As in the case of other dipterous larvae, the population was reduced to a very low level in the summer of 1949. The greatest number of specimens was collected during the winter months. Lindeman (1941a) reported more individuals in Cedar Bog Lake during December than in any other month in 1936 and 1938. *Chaoborus punctipennis* (Say) was the only other dipteran collected in significant numbers. Specimens of this species which were collected during most of this study indicated the total population to be small.

Four families of trichopterans, namely, Hydroptilidae, Leptoceridae, Limnophilidae, and Phryganeidae, were represented in the pond community. The larval stage of *Phryganea* crept actively over the masses of filamentous algae and pondweed. The cases of *Mystacides* and *Agraylea* were attached for the most part to the stems and leaves of *Potamogeton berchtoldi*. All trichopterans were much more common during the period prior to the winterkill. This was particularly true of the minute species, *Agraylea multipunctata*, which was easy prey for leeches.

The population of coleopterans was meager throughout this study with the exception of Halipilidae. The absence of many species of Coleoptera was perhaps correlated with the extensive mats of algae (*Aphanizomenon* and *Hydrodictyon*) and duckweed. Wilson (1923) concluded that the presence

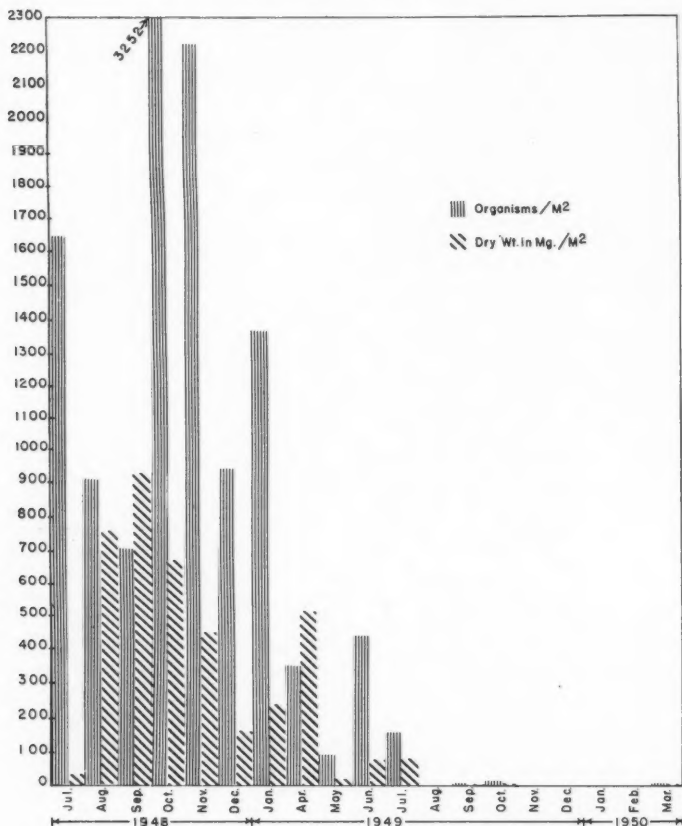


Fig. 6.—Seasonal populations of Chironomidae.

of a mat of vegetation of any sort that covered a high per cent of the surface of a pond was extremely unfavorable to aquatic beetles except species of Haliplidae. The larval haliplids observed by the present author were associated with masses of *Spirogyra*. A maximum population of 78 larvae per sq. M was collected in October 1948. *Haliplus* was the common genus. *Lacophilus proximus* was the only species of Dytiscidae and a single species of *Hydrophilus* represented the Hydrophilidae. Occasionally adult gyrimids were observed, but very few larvae were collected.

The population of Hemiptera was represented by three families, namely, Notonectidae, Corixidae, and Belostomatidae. The small notonectid, *Plea striola*, and a corixid, *Arctocorixa* sp., were common. *P. striola* was taken in

considerable numbers in the Ekman dredge collections during the winter. The population was greatest during the second winter; reaching a maximum of 344 per sq. M in December 1949. A larger notonectid, *Notonecta* sp., and the genus *Belostoma* (Belostomatidae) were collected in limited numbers.

The population (approximately 10 per sq. M) of small dragonfly naiads (Libellulidae) was very constant from July 1948 to January 1949. Many individuals were killed by the severe winter conditions. Emergence occurred in April 1949 and very few specimens were collected during the remainder of this study. Likewise, the naiads of damselflies (Caenagrionidae), common during the early part of this study, were absent after June 1949. A heavy winterkill and predation were probably the major contributing factors in practically eliminating the representative species of Odonata from the pond community.

Naiads of the genus *Caenis* were very common in July 1948 (220 per sq. M). Many adults emerged during the succeeding two months, reducing the naiad population to less than 10 per sq. M. A population of 130 per sq. M was recorded for October. This population gradually diminished during the fall and winter. There was not the expected increase following the emergence period in the spring of 1949. However, the population of *Calibaetis brevicostatus* Daggy, was not significantly different during the two summers. The adults emerged in early spring and in August and September. The largest populations, 350 and 160 per sq. M, appeared in October in 1948 and 1949, respectively.

DYNAMICS OF THE POND COMMUNITY

The aquatic community examined during this study is a successional stage of a community which has existed since the Pleistocene glaciation period. The basin was formed probably by a small block of ice. When the ice melted and filled the basin with water, a pond more than seven meters deep was created with an area considerably larger than the existing pond. The annual deposition of plants and animals and erosion (wind and water) have been major forces in altering conditions of the pond community. Recent activities of man, namely, cultivation, road construction, and drainage also hastened the filling of the pond. Thus, an aquatic community which was perhaps a large permanent pond was gradually reduced in area and depth until at present it is beginning to show some aspects of a temporary pond community. Dr. Samuel Eddy, University of Minnesota, recalled that in 1934 the pond was dry during the summer. During this study (winter of 1948-49) the pond froze to the bottom.

At the beginning of this study a more or less "balanced" condition existed with fishes as the top predators. The fish population indicated that the pond had not been dry nor frozen to the bottom for at least three years prior to this study. However, when the top predators were eliminated from the community by a complete winterkill in 1949, the populations of many other organisms lower in the food web were altered greatly. Many of the biotic relationships and changes in the dynamics have been discussed in the previous sections on plankton and bottom fauna, pp. 358 and 363. Recently, Ball and Hayne (1952) reported similar results when fishes were removed from a lake by poisoning.

In order to understand more completely the dynamics of the pond community an attempt was made to measure productivity. Lindeman (1942) and Juday (1940) stated that the year is generally the most useful time unit for expressing productivity. The annual yield is complicated by the differences in turnover of organisms. Thus, it was necessary to estimate separately the productivity of various groups of organisms. The primary food groups, which were analyzed quantitatively during the study, were as follows: (1) browsers, (2) benthic predators, (3) plankton predators, (4) swimming predators (fishes excluded), (5) zooplankters, (6) phytoplankters, (7) submerged rooted aquatic plants, and (8) *Hydrodictyon* and Lemnaceae. Quantitative measurements of other portions of the food web were not included within the scope of this study, namely, the dissolved nutrient substances, various groups of bacteria, and certain species of filamentous algae, rotifers and protozoa.

The ash-free dry weights of the browsers and the predators (benthic, plankton, swimming) were determined largely from Ekman dredge collections. It was necessary to estimate the percentage of zooplankters, phytoplankters, and debris in the plankton collections. Both net and the nannoplankton collections (water samples) were used. Some of these were almost 100% animal life while others were largely plant life. A summary of weight measurements

TABLE 11.—Monthly weight of food groups (g/M², ash-free dry wt.)

Date	*Swimming predators	Plankton predators	Benthic predators	Browsers	Zoo-plankton	Phyto-plankton
Jul. 1948	0.08	0.01	0.77	0.83	0.25	1.05
Aug.	1.00	0.01	1.82	1.01	0.60	0.88
Sep.	1.87	0.00	1.59	2.60	0.16	0.83
Oct.	2.52	0.03	1.23	1.49	0.09	0.43
Nov.	3.12	0.04	1.37	0.94	0.08	0.32
Dec.	3.24	0.06	1.44	0.49	0.04	0.58
Jan. 1949	2.69	0.06	0.64	0.51	0.00	0.00
Apr.	0.93	0.02	0.43	0.55	0.14	0.10
May	0.47	0.01	0.61	0.17	0.10	1.60
Jun.	0.92	0.01	0.93	0.18	0.61	1.73
Jul.	0.81	0.01	1.66	0.79	0.45	1.43
Aug.	0.99	0.01	1.34	0.01	0.63	1.22
Sep.	1.46	0.01	1.83	0.17	0.48	1.47
Oct.	1.69	0.01	2.80	0.65	0.14	1.59
Nov.	0.94	0.05	2.74	0.33	0.10	0.52
Dec.	0.65	0.15	2.96	0.22	0.11	0.60
Jan. 1950	1.10	0.06	2.43	0.90	0.08	0.70
Feb.	0.80	0.05	1.73	0.78	—	—
Mar.	0.52	0.09	1.23	0.72	—	—

* Fishes not included.

TABLE 12.—Standing crop of major plant food groups (g/M², ash-free dry wt.)

<i>Potamogeton berchtoldi</i>	Aug. 1948	8.10
	Aug. 1949	10.20
<i>Hydrodictyon</i> and Lemnaceae	Aug. 1948	25.2
	Jul. 1949	37.0

for these food groups is given in table 11. The standing crop of pondweed, *Potamogeton berchtoldi*, was determined in the latter part of August 1948 and 1949, the maximum period of growth. Each average weight (table 12) is based on collections from 50 quadrats (sq. M). *Hydrodictyon* and Lemnaceae were collected from a series of quadrats during the early part of August in 1948 and the last week of July in 1949. The weights (table 12) were determined as a single mass of vegetation because of the mechanical difficulties of separating the two plants. These were periods of maximum production of the *Hydrodictyon*.

According to Juday (1940) the rate of turnover in the plankton crop depends mainly upon the rate of reproduction which is affected by various chemical, physical, and biological factors. Juday estimated that the average turnover in organic matter of the mean standing crop of plankton occurs every two weeks throughout the year. Lindeman (1941a) considered that phytoplankters completed their life cycles every week during the summer (May-Sept.) and every two weeks during the other months. In this study the annual production of phytoplankton was calculated in approximately the same manner as that of Lindeman (1941a). The zooplankton indicated an average turnover approximately every two weeks. All predators were considered to average approximately one generation a year. Data indicated two generations a year for the browsers. The annual production of *Hydrodictyon* and Lemnaceae was arbitrarily considered to be twice the maximum standing crop; certainly a conservative estimate. The maximum standing crop of pondweed was assumed to be equal to the annual production.

In order to compare these data with that of previous workers, the dry weights (tables 11, 12) were converted to annual gram calories per square centimeter. Birge and Juday (1922) chemically analyzed various aquatic organisms and Lindeman (1941a) calculated generalized factors for the conversion of dry weight values to gram calories per square centimeter (table 13).

TABLE 13.—Factors for conversion of food group weight values (g/M²) to food values (g-cal/cm²) (from Lindeman, 1941a)

Food Group	From Dry Weight
Nannoplankton	2610
Net phytoplankton	2525
Pondweed	3500
Zooplankton	5800
Plankton predators	5330
Browsers	5000
Benthic predators	5000
Swimming predators	6000

After annual production of the various food groups was calculated in gram calories per sq. centimeter per year, the food groups were arranged in trophic levels as determined by the study of food web dynamics. Chlorophyll-bearing plants formed the primary producers level; browsers and zooplankters the primary consumer level; and predators (excluding the fishes) the secondary consumer level. Fishes which were present during the first year were top consumers (third consumer level), however, quantitative measurements were not

determined. Annual production of food groups at the producer level and the first two consumer levels are given in table 14 for 1948 and 1949. Also, percentages ratios of the annual production of food groups and trophic levels were calculated (table 15).

TABLE 14.—Annual production of food groups in the pond community (g-cal/cm²)

	1948	1949
Phytoplankters	6.0	9.3
Pondweed	2.8	3.6
Hydrodictyon and duckweed	15.2	22.2
Zooplankters	2.2	2.9
Browsers	0.9	0.5
Plankton predators	0.02	0.02
Benthic predators	0.5	0.8
Swimming predators	0.8	0.6
Total Producers	24.0	35.1
Total Consumers	4.42	4.82
Primary Consumers	3.1	3.4
Secondary Consumers	1.32	1.42

TABLE 15.—Percentage ratios of annual production of food groups

	1948	1949
Zooplankters/phytoplankters	36.6	31.1
Benthic predators/browsers	55.5	160.0
Plankton predators/zooplankters	0.9	0.7
Browsers/producers	3.8	1.4
Benthic predators/producers	2.1	2.6
Swimming predators/producers	3.3	1.7
Primary consumers/producers	12.9	9.7
Secondary consumers/producers	5.5	4.1
Secondary consumers/primary consumers	42.6	41.2

The populations of various organisms showed tremendous seasonal fluctuations in number and varied greatly from one year to the next. However, the magnitude of the annual variation of some organisms in the pond was amplified because the pond community was in a developmental stage between perennial and temporary conditions. Therefore, when the fishes (top predators) were eliminated from the community the invertebrate population lower in the food web changed greatly.

Phytoplankters formed a significant part of the producer group in the food web. They were consumed in part by the heterotrophic rotifer population, cladocerans, and copepods, however, no numerical relationship was evident. Pennak (1946) stated that there was not sufficient evidence to prove that grazing of zooplankters on phytoplankters was a significant biotic control. Detritus rather than living phytoplankters is perhaps equally as important to the zooplankters. The production of phytoplankton was 6.0 and 9.3 g cal cm²/yr for 1948 and 1949, respectively (table 14). Blue-green algae were much more abundant in 1949. Due at least in part, to the limit of water in the present pond, the production of plankters was much less than in the Cedar Bog Lake as reported by Lindeman (1941a).

The water level in 1948 perhaps limited the production of pondweed as compared to 1949. *Hydrodictyon* was more abundant in summer of 1949.

The organisms which formed the plankton predator group were few and constituted a minor part of the total food web. This is indicated by the very low ratio of plankton predators to zooplankton (table 15).

Pronounced predator-prey dynamics were indicated by the great increase in the snail leech population (benthic predators) from 1948 to 1949. The leech population increased as a result of the winterkill of fishes. Likewise, the browsers, namely, small oligochaetes, snails and chironomids were reduced to approximately one half, primarily because of predation by the huge snail leech population. The high ratios (table 15) of the annual production of benthic predators to browsers suggested that leeches consumed some plant materials. Lindeman (1941a) reported high ratios of 67.6 and 40.0 per cent for the Cedar Bog Lake Community in 1938 and 1940, respectively. He concluded that these ratios indicated subminimal food supply for the predators and stated further that some evidence indicated that browsing may have alleviated such a condition. The weight measurements of leech populations in the present study suggested sub-minimal food supply for the snail leech in 1949 and 1950.

As stated by Lindeman (1942) various food groups form more or less discrete trophic levels, each successively dependent upon the preceding level as a source of energy with the producers directly dependent upon the rate of incident solar radiation as a source of energy. Thus, the total production of organisms in the quantitative relationship of any trophic level can be expressed in terms of its efficiency with respect to lower levels. Allee and co-workers (1949) stated:

... an interesting generalization may be made that, within a given community, the biological efficiencies increase as the rates of production, or productivities, decrease. . . . There is no reason to suppose that this productivity/efficiency ratio (p/e) is not universal for major communities in approximate biotic balance. We propose that this relationship be termed the Lindeman ratio, inasmuch as it was derived from his careful work.

Juday (1940) gives 118,872, g cal/sq. cm of surface as the mean annual quantity of radiation delivered to the surface of Lake Mendota over a period of 28 years. Since there is an insignificant difference in latitude, longitude and elevation between Lake Mendota and the pond community studied, Juday's estimate was used.

After the average annual, total production of organisms in each trophic level in the pond community was calculated ($\text{g-cal/cm}^2/\text{yr}$), the totals were corrected for dissipation of energy by respiration, predation and postmortem decomposition using the corrective factors of Lindeman (1942). Production and the efficiency of each trophic level are given in table 16. These factors for Cedar Bog Lake and Lake Mendota are included for comparison.

As emphasized previously the trophic levels were not absolutely discrete units in the food web. Some predator-prey relationship may occur within the higher trophic levels. It is a well-known fact that many predators vary their food habits in accordance with the availability of food items and not all of the organisms in each trophic level were completely dependent upon the organisms in the next lower trophic level in the present study. For example, the

TABLE 16.—Annual productivity and efficiency of trophic levels in the Minnesota pond, Cedar Bog Lake, and Lake Mendota (g-cal/cm²/yr)

	Pond		Cedar Bog Lake		Lake Mendota	
	Productivity	Efficiency	Productivity	Efficiency	Productivity	Efficiency
*Radiation	118,872	—	118,872	—	118,872	—
Producers	49.9	0.04%	111.3	0.10%	480	0.40%
Primary consumer ..	9.2	18.4%	14.8	13.3%	41.6	8.7%
Secondary consumers	3.4	36.9%	3.1	22.3%	2.3	5.5%
Tertiary consumers (Fishes) ..	—	—	—	—	0.3	13.0%

* Taken from Juday (1940).

common leech, *Erpobdella punctata*, was considered chiefly carnivorous, however, it also consumed some plant fragments and ooze. Therefore, the productivity and the efficiency of any trophic level are merely estimates which are open to some criticism. Nevertheless, quantitative estimates are the best that can be made in view of the inadequate knowledge regarding trophic relationships in natural bodies of water; but these estimates are doubtless in the correct order of magnitude.

The production of producers in the present study was considerably less than the production of those in Cedar Bog Lake and Lake Mendota (table 16). This was due in part to the relatively small production of phytoplankton. The complete area of the pond was shallow, consequently, the volume of water available for plankton was reduced. The production of primary consumers in the three bodies of water varied less than the production of producers and the production of secondary consumers varied least of all.

The biological efficiencies of the trophic levels, particularly the producers and secondary consumer levels in Lake Mendota, varied considerably from those in the present study. However, Lindeman (1942) believed that the production of the producers in Lake Mendota, as estimated by Juday, was too high. Also, he indicated that the production of the secondary consumers level was too low. Nevertheless, environmental conditions of Lake Mendota, such as depth and percentage of littoral area, differ greatly from those in the present pond community, therefore, it should be expected that the efficiencies would also differ.

The various trophic levels could be arranged into the well known Eltonian pyramid (Elton, 1927). The rate of production decreased from the producer level to the top consumer level while the biological efficiency increased from the producer level to the top consumer levels, thus, supporting the Lindeman ratio (p/e) designated as such by Allee and co-workers (1949).

The production of energy at the producer level in the pond community was 49.9 gram calories per square centimeter per year. Although the community received an estimated 118,872 gram calories per square centimeter annually, the producer level utilized only 0.04 per cent of this energy. In contrast, the production at the top consumer level was estimated at 3.4 gram calories per square centimeter annually with a biological efficiency of 36.9 per cent. Assuming the food chain to be a continuous process from producer level to top consumer level, the ultimate consumer level measured in the pond

community utilized only 0.0028 per cent of the original solar energy. In spite of the fact that the present pond is relatively fertile and produced abundantly, the dynamics show that the energy exchange from one trophic level to the next is low.

SUMMARY

An ecological study of a small pond in Minnesota was conducted over a period of nearly two years. At present, the pond is in a transitional stage between perennial and temporary aquatic community conditions.

The physical and chemical factors were analyzed. The bottom deposits (maximum deposition 4 M) were studied in some detail with respect to the developmental history of the pond.

A flourishing peripheral belt of emergent plants (*Sagittaria*, *Typha*, *Acorus*) was present. The annual deposition of organic matter from these was a major force in reducing the area and depth of the pond. Duckweed covered a large part of the pond during the warmer months. Algae were common particularly *Hydrodictyon* and *Aphanizomenon* which reached "bloom" stages during the summer. The production of algae was correlated with the chemical conditions of the water. *Potamogeton berchtoldi* was the only rooted aquatic plant.

Seasonal and annual variations in the populations of plants and animals were determined by quantitative measurements. The organisms in the pond community formed a food web which was in a "balanced" condition during the first part of this study, however, abnormal climatic conditions resulted in winter anaerobiosis and a complete winterkill of fishes (top predators). Consequently, the populations of various organisms lower in the food web were altered greatly. Pronounced predator-prey dynamics were indicated by the trophic relationships of the fishes, snail leeches and browsers.

The food web consisted of seven major food groups, namely, (1) phytoplankters, (2) zooplankters, (3) browsers, (4) plankton predators, (5) benthic predators, (6) *Hydrodictyon* and Lemnaceae, and (7) pondweed. The total annual production of each food group was determined.

The food groups formed fairly discrete trophic levels. The producer level included the chlorophyll-bearing plant (pondweed, phytoplankton, *Hydrodictyon* and Lemnaceae). The primary consumer level consisted of zooplankters and browsers. The secondary consumers included the predators except the fishes which during the first year of this study constituted a third consumer level.

The biological efficiency of each trophic level of the food web was computed by comparing the total production of organisms in each trophic level with the total production of organisms in the preceding level. The total production of organisms at each trophic level decreased while the biological efficiency increased from the lowest level (producer) to the top consumer level, thus, supporting the Lindeman ratio (p/e, Allee and co-workers, 1949). The dynamics of the pond community indicated that the exchange of energy, as measured by the production of organic materials, from one trophic level to the next is low even though the pond community was fertile and productive.

REFERENCES

- ALLEE, W. C. 1911—Seasonal succession in old forest ponds. *Trans. Ill. State Acad. Sci.* 4:126-131.
- , A. E. EMERSON, O. PARKS, T. PARKS AND K. P. SCHMIDT 1949—Principles of Animal Ecology. W. B. Saunders Co., Philadelphia.
- BALL, ROBERT C. AND DON W. HAYNE 1952—Effects of the removal of the fish population on the fish-food organisms of a lake. *Ecology* 33(1):41-48.
- BARNEY, R. L. AND B. J. ANSON 1920—Relation of certain aquatic plants to oxygen supply and to capacity of small ponds to support the top minnow (*Gambusia affinis*). *Trans. Am. Fish. Soc.* 50:268-278.
- BIRGE, E. A. AND C. JUDAY 1908—A summer resting stage in the development of *Cyclops bicuspidatus* Claus. *Trans. Wis. Acad. Sci. Arts and Letters* 16:1-9.
- AND ——— 1922—The inland lakes of Wisconsin. The plankton. Part I. Its quantity and chemical composition. *Bull. Wis. Geol. Nat. Hist. Surv.* 64:1-222.
- BOVEE, E. C. 1949—Studies on the thermal death of *Hyalella azteca* Saussure. *Biol. Bull.* 96:123-28.
- COLE, G. E. 1953—Notes on copepod encystment. *Ecology* 34:208-211.
- COWLES, R. P. AND A. M. SCHWITTALLA 1923—The hydrogen ion concentration of a creek, its waterfall swamp and ponds. *Ibid.* 4:402-417.
- EDDY, S. 1934—A study of fresh-water plankton communities. *Ill. Biol. Monogr.* 12(4):1-93.
- ELTON, C. 1927—Animal Ecology. Macmillan Co., N. Y.
- JUDAY, C. 1940—The annual energy budget of an inland lake. *Ecology* 21:438-450.
- KENK, R. 1949—The animal life of temporary and permanent ponds in southern Michigan. *Misc. Publ. Mus. of Zool. Univ. Mich.* No. 71.
- LAUTERBORN, R. 1901—Die "sapropelische" Liberwelt. *Zool. Anz.* 24:50-55.
- AND E. WOLF 1909—Cystenbildung bei *Canthocamptus microstaphylinus*. *Ibid.* 34:130-136.
- LINDEMAN, R. L. 1941a—Seasonal food-cycle dynamics in a senescent lake. *Amer. Midl. Nat.* 26:636-673.
- 1941b—The developmental history of Cedar Creek Bog, Minnesota. *Ibid.* 25:101-112.
- 1942—The trophic-dynamic aspect of ecology. *Ecology* 23:399-419.
- MACKENTHUN, K. M., E. F. HERMAN AND A. F. BARTSCH 1945—A heavy mortality of fishes resulting from the decomposition of algae in the Yahara River, Wis. *Trans. Am. Fish. Soc.* 75:175-180.
- MARKUS, H. C. 1934—Life history of the fat-head minnow (*Pimephales promelas*). *Copeia* (3):116-122.
- MOORE, W. G. 1942—Field studies on the oxygen requirements of certain fresh-water fishes. *Ecology* 23:319-329.
- MOYLE, J. B. 1946—Some indices of lake productivity. *Trans. Am. Fish. Soc.* 76:322-334.
- MOZLEY, A. 1932—A biological study of a temporary pond in Western Canada. *Am. Nat.* 66:235-249.
- OOSTING, H. J. 1933—Physical-chemical variables in a Minnesota lake. *Ecol. Monogr.* 3(4):493-533.
- PENNAK, R. W. 1946—The dynamics of freshwater plankton populations. *Ibid.* 16:339-356.
- PETERSON, W. 1926—Seasonal succession of animals in a Chara-cattail pond. *Ecology* 7:371-377.
- PHILIP, C. B. 1927—Diurnal fluctuation in the hydrogen ion activity of a Minnesota lake. *Ibid.* 8:73-89.
- SHELFORD, V. E. 1911—Seasonal Succession. II. Pond Fishes. *Biol. Bull.* 21:127-151.
- STANDARD METHODS OF THE EXAMINATION OF WATER AND SEWAGE 9th ed. 1946. Am. Publ. Health Assoc. N. Y.
- WARD, E. B. 1940—A seasonal population study of pond Entomostraca in the Cincinnati region. *Amer. Midl. Nat.* 23:635-691.
- WILSON, C. B. 1923—Water beetles in relation to pondfish culture, with life histories of those found in fishponds at Fairport, Iowa. *Bull. U. S. Bur. Fish.* 39:231-345.

Summer Plankton of Lake Amatitlan, Guatemala*

Richard S. Peckham and Clarence F. Dineen

University of Notre Dame, Notre Dame, Indiana

Previous studies of plankton from Guatemala lakes, by Meek (1908); Clark (1908); and Tilden (1908); have been purely *qualitative* in nature. Juday's (1916) limnological study of Lake Amatitlan, however, included a single series of *quantitative* plankton collections at various depths. The present paper is a report on a series of quantitative collections taken from Lake Amatitlan over an eight-week period during the summer of 1951.

General description of the lake.—Lake Amatitlan is of volcanic origin and is situated at 90°30' west longitude and 14°25' north latitude in the Republic of Guatemala. It is eight miles long, 2½ miles wide and with a surface of 3870 feet above sea level. A crossing of the International Railways of Central America divides the lake into two basins. Mountains, 4670-5170 feet above sea level, surround the lake; those of the northwest are composed of granite; the others are principally of volcanic ash, pumice, and other loose materials which are easily eroded. The mountains to the north and northwest show evidence of erosion in the form of huge cuts which are visible for several miles. Entering the lake on the north side is the Villalobos (Lobos) River, which is the main affluent stream during the dry season. The single outlet is the Michatoya River which drains the northwest basin from the south. The greater part of the lake shore is steep, especially to the east and southeast. Half or more of the north and northeast shores consist of a broad, low plain which has been built up by the Lobos River and temporary streams which enter the lake from the north and northwest during the rainy season (May-November).

The surface temperature of the lake throughout the period of this investigation remained quite uniform, never varying more than 4.2° C during the day, but dropping 3 or 4 degrees within a few hours after sunset. The water was moderately clear, a white disc 9½ inches in diameter was visible at depths ranging from 10-13½ feet throughout this study.

Methods.—Collecting stations were chosen in areas which insured adequate sampling and yet remained in the practical limits of the investigation. In the southeastern part of the lake, known locally as the "Laguna," weekly quantitative collections of surface (0-2m) plankton were made at three stations situated in areas of horizontal flow, aquatic vegetation, and deep center. All quantitative collections (84) were made with a hand net of no. 25 mesh bolting silk (100 liters of water being strained).

Quantitative counts were made with the aid of a Sedgewick-Rafter counting chamber (1 ml) and a compound microscope. At least 1 ml of concentrate was examined for each plankton excepting those organisms which were

* The material for this paper was taken from a thesis submitted to the University of Notre Dame, Notre Dame, Indiana, in partial fulfillment of the requirements for the degree of Master of Science.

very abundant. Counts obtained from the three main stations were averaged and the resulting values utilized in the quantitative treatment of the plankton (table 1).

A definite quantitative value, equalling one unit, was assigned to each plankter for purposes of enumeration and comparison. The following check list, with quantity equalling one unit designated, includes all species collected during this study.

CHECK LIST OF PLANKTON SPECIES

Chlorophyceae

Bulbochaete sp.	1 filament	Oocystis sp.	1 colony
Closterium aciculare T. West ..	1 cell	Scenedesmus bijuga (Turp.) ..	8 cells
Closterium cucumis Ehr.		Scenedesmus arcuatus var.	
Cosmarium sp.	1 cell	platydiscus G. M. Smith	8 cells
Eudorina elegans Ehr.	1 colony	Sirogonium sp.	1 filament
Gloeocystis sp.	2 cells	Spirogyra sp.	1 filament
Gonatozygon sp.	1 cell	Staurostrum leptocladum Nordst	1 cell
Hydrodictyon sp.	5 cells	Staurostrum spp.	1 cell
Nephrocitium sp.	4 cells	Zygnema sp.	1 filament
Oedogonium sp.	1 filament		

Dinophyceae

Ceratium hirundinella (O.F.M.) Schrank	1 cell	Peridinium tabulatum Ehr.	1 cell
--	--------	--------------------------------	--------

Bacillariophyceae

Cyclotella sp.	1 cell	Staureneis sp.	1 cell
Epithemia sp.	1 cell	Surirella guatemalensis Ehr.	1 cell
Fragillaria sp.	1 cell	Surirella sp.	1 cell
Melosira sp.	400 micra	Synedra sp.	1 cell
Navicula sp.	1 cell	Terpsinoe musica Ehr.	1 cell
Rhopalodia sp.	1 cell		

Myxophyceae

Anabena sp.	1 filament	Gloeotrichia sp.	1 trichome
Aphanocapsa sp.	1 colony	Gomphosphaeria aponina Kutz.	1 colony
Botryococcus Braunii Kutz.	1 colony	Lyngbya sp.	1 filament
Coelosphaerium sp.	1 colony	Merimospedia glauca (Ehr.) ..	32 cells
Chroococcus limneticus Lemm.	12 cells	Polycystis aeruginosa Kutz.	10,000 sq. micra
Eucapsis alpina Clement & Schantz	32 cells		

Protozoa

Arcella sp.	1 individual	Epipyxis sp.	1 individual
Carchesium sp.	1 individual	Epistylis sp.	1 individual
Centropyxis aculeata Stein	1 individual	Vorticella sp.	1 individual
Dinobryon sp.	1 individual		

Rotatoria

Asplanchna brightwellii Gosse	1 individual	Filinia longiseta Gosse	1 individual
Brachionus sp.	1 individual	Keratella cochlearis Gosse	1 individual
Diurella sp.	1 individual	Lecane sp.	1 individual
Euchlanis sp.	1 individual	Monostyla sp.	1 individual
Eretmia sp.	1 individual	Platylas quadricornis (Ehr.) ..	1 individual

Cladocera

Ceriodaphnia lacustris	Birge	1 individual	Daphnia longispina	
Ceriodaphnia pulchella	Sars	1 individual	(O.F.M.)	1 individual

Copepoda

Diaptomus amatitlanensis			Mesocyclops inversus	
Wilson	1 individual		Kiefer	1 individual

Discussion.—The total plankton reached a maximum on August 8-9 of 1,164,465 units per 100 liters. A minimum of 157,641 units per 100 liters occurred on June 27-28 (table 1).

Phytoplankton.—The phytoplankton consistently exceeded the zooplankton, never falling below 97% of the total plankton. The phytoplankton contained 38 genera representing four classes: Chlorophyceae, Dinophyceae, Bacillariophyceae, and Myxophyceae.

Chlorophyceae (green algae; fifteen genera) were in greatest abundance throughout the study with an average of 188,181 units per 100 liters. Of the desmids, the major group of green algae, *Staurastrum leptocladum* and *Closterium aciculare*, were the most abundant species. *Eudorina elegans* appeared in all samples. Autocolonies of this species were observed from July 18 until the end of the collecting period. *Oocystis* sp. was common in most of the samples, the colonies being composed of 6 or 8 cells. The genus *Scenedesmus* represented by *S. arcuatus* var. *platydiscus* and *S. bijuga* was present in small numbers in the majority of the collections. The other genera, listed in the checklist, appeared intermittently in the samples and were quantitatively insignificant.

Dinophyceae (dinoflagellates) were few in species but abundant in individuals. *Ceratium hirundinella* was the predominant member of the class. All forms observed were of the four-horned type. Clark (1908) reported the majority of the individuals of this species to be of the three-horned type. *Peridinium tabulatum* occurred frequently in all samples.

Bacillariophyceae (diatoms) usually were not prominent members of the summer plankton although on August 8-9, approximately 54% of the total plankton consisted of *Melosira* spp. No other plankter exceeded this maximum in a single sample. Nine additional genera appeared in the collections in small numbers.

Myxophyceae (blue-green algae) were in greatest abundance during the early part of the summer, eleven genera being represented. *Polycystis aeruginosa* was the predominant species with a minimum of 10,444 units per 100 liters on August 8-9 and a maximum of 41,333 units per 100 liters on June 27-28.

TABLE 1.—Weekly totals of phytoplankton and zooplankton groups with total plankton population (units/100 liters)

Phytoplankton	Jun. 20	Jun. 27-28	Jul. 4	Jul. 11
Chlorophyceae	89297	75664	39104	71231
Dinophyceae	241040	36477	121580	221408
Bacillariophyceae	2737	3368	799	1938
Myxophyceae	26214	41475	12561	20358
Total	359288	156984	174044	314930

TABLE 1 (continued)

Zooplankton	Jun. 20	Jun. 27-28	Jul. 4	Jul. 11
Copepoda	798	222	2420	2837
Rotatoria	1287	413	817	583
Cladocera	19	3	48	265
Protozoa	30	19	11	42
Total	2134	657	3296	3727
Phytoplankton	Jul. 18	Jul. 25	Jul. 31	Aug. 8-9
Chlorophyceae	100268	205890	497969	426028
Dinophyceae	312932	247812	144219	96008
Bacillariophyceae	2865	18330	255665	628054
Myxophyceae	13752	15364	16015	10632
Total	429817	487396	913868	1160722
Zooplankton	Jul. 18	Jul. 25	Jul. 31	Aug. 8-9
Copepoda	9035	6989	3810	1894
Rotatoria	721	986	961	535
Cladocera	191	276	783	1301
Protozoa	38	49	22	13
Total	9985	8300	5576	3743

Zooplankton.—At no time during the study did the zooplankton exceed 3% of the total plankton. A total of twenty-one genera of Protozoa, Rotatoria, Cladocera, and Copepoda were collected.

Protozoa. Of seven genera collected none appeared in sufficient numbers to allow consideration of the protozoa as an important constituent of the zooplankton. *Centropyxis aculeata*, primarily a bottom dweller, appeared most frequently in the samples from the shallow, weedy area.

Rotatoria. Rotifers were exceeded in number of individuals only by the copepods. *Keratella cochlearis* appeared most frequently with maxima and minima at two week intervals. *Asplanchna brightwellii* appeared in considerable numbers in the latter part of July. Eight additional genera were collected (see check list).

Cladocera were few in number until July 11 when 265 individuals per 100 liters were collected. The species represented were *Daphnia longispina*, *Ceriodaphnia lacustris*, and *Ceriodaphnia pulchella*.

Copepoda constituted the most important group of zooplankton. *Mesocyclops inversus* appeared in all samples with a minimum of 12 individuals per 100 liters on June 27-28 and a maximum on July 31 of 1193 individuals per 100 liters. *Diaptomus amatitlanensis* appeared regularly in the majority of the collections. Nauplii and metanauplii were present in great numbers in most samples throughout the summer.

Summary.—Weekly collections of surface plankton from June 20 to August 9, 1951, were made at three stations on Lake Amatitlan, Guatemala. Phytoplankton was predominant in the eighty-four quantitative samples examined. Thirty-eight genera comprising four classes, Chlorophyceae, Dinophyceae, Bacillariophyceae, and Myxophyceae, were identified. The predominant green alga was *Staurastrum leptocladum*, *Ceratium hirundinella* among the

Dinophyceae, *Melosira* sp. for the diatoms, and *Polycystis aeruginosa* among the blue-green algae.

The zooplankton constituted twenty-one genera of Copepoda, Rotatoria, Cladocera, and Protozoa. The predominant species of each group were *Mesocyclops inversus*, *Keratella cochlearis*, *Daphnia longispina*, and *Centropyxis aculeata*, respectively.

The following species constitute new records for Lake Amatitlan: Chlorophyceae: *Closterium aciculare*, *Closterium cucumis*, *Scenedesmus arcuatus* var. *platydiscus*, *Scenedesmus bijuga*, *Staurostrum leptocladum*; Bacillariophyceae: *Terpsinoe musica*; Myxophyceae: *Chroococcus limneticus*, *Eucapsis alpina* (?); Protozoa: *Centropyxis aculeata*; Rotatoria: *Asplanchna brightwellii*, *Platylas quadricornis*; Copepoda: *Mesocyclops inversus*.

REFERENCES

- CLARK, H. W. 1908—The holophytic plankton of lakes Atitlan and Amatitlan, Guatemala. Proc. Biol. Soc. Wash. 21:91-106.
- JUDAY, C. 1916—Limnological studies on some lakes in Central America. Trans. Wis. Acad. Sci. 18:214-250.
- MEEK, S. E. 1908—The zoology of lakes Amatitlan and Atitlan, Guatemala, with special reference to ichthyology. Field Col. Mus. Zool. 7:159-206.
- TILDEN, J. E. 1908—Notes on a collection of algae from Guatemala. Proc. Biol. Soc. Wash. 21:153-156.

Studies on the Formation and Function of Mucoids in Cercariae: Non-irgulate Xiphidiocercariae*

F. J. Kruidenier

University of Illinois, Urbana

In the course of an investigation of the formation and function of meta-chromatic mucoids in irgulate cercariae (Kruidenier, 1951), parallel studies of the non-irgulate xiphidiocercariae were undertaken. Among the latter L  he (1909) differentiated an ornate group primarily by the presence of a delicate fin fold along the tail, an armate group with bodies longer than 0.25 mm., and microcotylous cercariae with bodies less than 0.20 mm. Subsequent investigators have tentatively accepted these groupings (Dubois, 1929), suggested further divisions (Cort, 1915, Sewell, 1922) or recommended entirely different bases of classification (Lebour, 1911). Studies by McCoy (1928), Crawford (1937), McMullen (1935) and others amply confirm the close relationship which exists among the parasites included in these larval groups, indicating that such schemes, justified largely by their convenience, may not represent an actual genetic classification. Such criteria as the form of the excretory bladder, suggested by McMullen (1937), may aid in the establishment of more valid taxonomic groupings of the xiphidiocercariae.

ACKNOWLEDGMENTS

Sincere gratitude for valued suggestions and criticisms is expressed to Professor George R. LaRue, under whose direction this investigation was undertaken. Due credit is also given to Professor A. E. Woodhead of the Zoology Department of the University of Michigan for his many helpful suggestions.

Materials and methods.—Two species of ornate cercariae, *C. longistyla* McCoy 1929 and that of *Macroderoides typicus* (Winfield, 1929), one species of the polyadenous armate cercariae, *C. isocotylea* (Cort, 1914), and two species of microcotylous cercariae, that of *Alloglossidium corti* (Lamont, 1921) and an undetermined species from *Goniobasis livescens* Menke (1830), are considered in this report. With the exception noted, these species were obtained from *Lymnaea palustris* and *Helisoma trivolvis* collected near Ann Arbor, Michigan. No attempt was made to follow the life histories of the cercariae so that identification is tentative, based entirely on morphological comparisons. The infected *G. livescens* were also obtained from the Huron River in the same area. Living specimens and whole mount preparations of normally emerged and developing cercariae, fixed in saturated aqueous corrosive sublimate, were employed in these studies. Bouin-fixed serial sections of entire infected snails were used to supplement the studies of the cercariae of *M. typicus*, *C. longistyla*, and the cercaria from *G. livescens* although the value of such sections was limited by the usually oblique angles of the sections through specimens and the difficulty of following individuals among

* Contribution of the departments of zoology of the universities of Michigan and Illinois.

the tremendous numbers of developing cercariae present in consecutive sections. Serial sections of normally emerged *C. longistyla* and *M. typicus* were also studied.

Dilute aqueous thionin and toluidin blue were employed to differentiate mucoid substances in all of the cercariae. Non-metachromatic tissues of the cercariae as well as mucoid and non-mucoid elements in the snails served as controls for the series of stain reaction. Delafield's haematoxylin, with and without eosin counterstain, was also used.

Caudal pockets.—Faust (1917) noted that the caudal pockets of certain xiphidiocercariae contain a viscous material which he termed "mucous" in the sense of an undetermined thick or slimy substance. The demonstration of a highly metachromatic substance within the caudal pockets of emerged cercariae (Kruidenier, 1947), a mucoid in the sense of some combination of hexose sugar and protein moieties, led to the further consideration of the caudal pockets and of the developing non-irrigate xiphidiocercariae.

The tails of cercariae in armate, ornate and microcotylous groups, as reported, insert subterminally into a postero-ventral groove, usually lined with a thickened cuticula and armed with elongate, sturdy spines. These characteristics, noted by Schwartz (1886) for *C. armata*, are not described uniformly in all non-irrigate xiphidiocercariae (e.g. *C. helvetica* Dubois, 1929 and *C. crenata* Faust, 1917). Variable lateral recesses or pockets are frequently described on either side of the tail stem and are termed caudal pockets by most investigators (Faust, 1917, Dubois, 1929, Miller, 1936, *et al.*). They have been considered as spinous organs for the attachment of the tail (Leuckart, 1886) and the homologues of the locomotor appendages of the monostomes (Faust, 1917).

Among the cercariae considered in the present investigations, Crawford (1937) pictured the caudal pockets of *A. corti*, Faust (1918) described them in *C. isocotylea*, and Hussey (1941) discussed them in *M. typicus*. These investigations confirm the observations of the previous investigators and demonstrate caudal pockets in *C. longistyla* (Figs. 29, 34). No caudal pockets are demonstrable in the undescribed microcotylous cercaria from *G. livescens* (Fig. 25).

Interspecific size variation of the caudal pockets occurs (Figs. 29, 37, 39) but may be masked by marked apparent variations in the same species of cercariae (Figs. 35-37). The latter correlates with the emerged age of the cercariae and the progressive discharge of mucoid substances from their caudal pockets. It may lead to the almost complete disappearance of that structure.

The excretory ducts from their bladders open into the ventral groove in all of the species except *M. typicus* in which it opens directly into the caudal pocket complex. In the latter species the alae of the caudal pockets form a single bilaterally symmetrical chamber (Fig. 34), appearing as a dilation along the excretory duct which then leads into the ventral groove dorsal to the tail stem. As observed by Hussey (1941) the "caudal pocket may appear to be a part of the bladder," cuticularized and spinose. Similar structures described in *C. pachystata* and *C. tetradena* by Miller (1936) and by Dubois (1929) for *C. helvetica* IV may also prove to be caudal pockets.

The tails of cercariae with caudal pockets retain a nearly terminal position

until late in cercarial development. They are then shifted to a sub-terminal position by the differential growth of the posterior body tissues which results in the formation of the ventral groove and the caudal pockets. The greater complexity of the caudal pocket in *M. typicus* appears to be the result of a more pronounced differential growth, evidenced by a greater anterior "migration" of its tail.

Mucoid glands.—Several types of glands have been described in the non-irrigulate xiphidiocercariae. The presence of numerous cystogenous glands and complements of penetration glands is readily confirmed. The penetration glands are refractory to dilute thionin and toluidin blue, in which they stain a very faint blue-green, and the cystogenous glands are more chromophilic but generally orthochromatic in these dyes under the conditions of staining employed.

Large, ventral cells with a clear hyaline cytoplasm, the "Blasenzellen" of *C. armata* (Schwartz, 1886), appear similar to glands described for *C. crenata* and *C. glandulosa* by Faust (1917) as are others reported in *C. helvetica* IV, *C. helvetica* V and *C. helvetica* XXX and considered characteristic of the xiphidiocercariae by Dubois (1929). Apparently homologous glands have been studied in irrigulate cercariae (Kruidenier 1947, 1951) and are present in the armate, ornate and microcotylous cercariae considered in the present investigations.

The nearly homogeneous contents of these glands are highly chromophilic to hematoxylin under proper conditions of fixation and stain. They color a brilliant metachromatic-red in very dilute aqueous thionin and toluidin blue in marked contrast to the orthochromatic-blue reactions of other tissues in identical cercariae and the adjacent non-mucoid tissues of the infected snails. They are thus presumptive mucoids. The persistence of their brilliant metachromatic staining reaction through rigorous alcoholic dehydration demonstrates their strongly mucinous nature possibly indicating that they are high molecular weight sulfuric esters of protein-hexose sugar compounds (see Lison, 1935). The cercarial glands are more highly metachromatic than are the mucoid substances in the snail tissues in identical sections and are comparable in metachromasy to the mucus in bronchial and intestinal epithelia of mammals. The nuclei and large nucleoli of the glands stain poorly in dilute solutions of thionin and toluidin blue. More concentrated dyes color the mucoid substances so deeply that the nuclei appear only as clear vesicles within the masses of secretion.

The mucoid glands of the non-irrigulate xiphidiocercariae investigated tend to branch and lobulate profusely with consequent diffusion of the glands. Such morphological irregularities, especially prominent in *C. longistyla* and *M. typicus*, appear somewhat more pronounced in the glands of entire specimens than in the cercariae sectioned *in situ* in snails. This impression may be due in part, however, to the different views of the entire glandular complex afforded by whole mounts and the partial complement of the glands visible in sectional planes. Dissecting cercariae into anisotonic saline media heightens existing irregularities and induces abnormalities of their mucoid glands, accounting for discrepancies between sectioned and whole mount specimens. However, preparations that demonstrate dendrites in immature glands of *C. iso-*

cotylea, *A. corti* and the cercaria from *G. livescens* also show their relatively complete disappearance from the more mature glands of these species. This indicates that they are not artifacts and the presence of profuse dendrites from the glands of *in situ* cercariae confirms this. While all of the glands of these non-irgulate cercariae branch into adjacent intercellular spaces, those anterior to the acetabulum are the most irregular (Figs. 3, 8, 19, 24). Usually the major branches as well as their minor extensions are directed toward the adjacent ventral surfaces of the cercariae.

The large mucoid glands are located bilaterally along the mid-ventral line from the oral suckers to the tail stems of the cercariae, anterior, lateral and posterior to their acetabula. They develop immediately beneath the ventral surfaces of the cercariae (Figs. 1, 5, 10, 16, 17, 23) and extend into the more dorsal tissues in proportion to their final accumulation of secretion. In general their dendrites decrease in complexity as the glands become swollen with secretion.

In *M. typicus* those glands which lie anterior to the acetabulum do not produce as much mucoid as do the circum-acetabular and post-acetabular glands and they retain a greater number of their complex branching processes at maturity (Fig. 8). The resultant morphological differences between the variously located glands is thus only apparent and is not fundamental. A network of highly metachromatic strands is produced anteriorly simulating a series of small glands with overlapping branches and ducts. Posteriorly a more distinct group of closely associated, multi-lobed glands is present. The circum-acetabular glands most closely resemble the posterior group morphologically. Their lobate processes follow the limiting membrane of the acetabulum mesiad and inward instead of being directed toward the surfaces of the cercariae (Fig. 9).

The mucoid glands which develop in *C. longistyla* form the most complex, interlacing network (Figs. 3, 28) that is encountered in any of the described cercariae. A narrow, clear area, indistinct terminally and in the mid-body region separates a series of lateral accumulations of mucoid from the mesially developing glands. The lateral accumulations are interconnected with the mesial glands by very delicate or attenuate processes (Figs. 2, 3, 26, 28). Such connections arise as major dendrites that extend from the mesial glands into the lateral fields during development (Fig. 26). Single processes, developing thus, branch profusely at their terminations. These branches fill with mucoid and become lobate during the later secretory phase of the cells and the connections between terminal lobes and the mesial glands remain inconspicuous. Several terminally dendritic processes may radiate from individual glands. The general aspect is that of numerous small lateral glands which appear later than the median glands, but all become filled with mucoid at about the same stage of cercarial development (Fig. 28). The simultaneous but slightly delayed appearance similarly produces the false impression of independent glands.

A series of mucoid masses also develop within the limits of the oral suckers of nearly mature *C. longistyla* before these cercariae escape from their sporocysts but subsequent to the complete discharge of the body glands. A lack of any association with the mucoid body glands and the ducts from the



FIGURES 1-25

1-3. Developmental stages of *C. longistyla* showing maturation of mucoid glands and formation of lateral reservoirs. Note complexity of glands and their lateral dendrites in Fig. 3. 4. Anterior end of *C. longistyla* showing details of mucoid glands within oral sucker. 5-8. Developmental stages of *C. Macroderoides typicus*. Note dendritic processes of anterior glands in Figs. 10, 11. 9. *Macroderoides typicus* after discharge of anterior mucoid glands. The caudal pocket is not yet visible. Ventral view. 10-13. Developmental stages of *C. Alloglossidium corti*. 14. Non-emerged *C. corti* showing peripheral distribution and ventral concentration of freshly discharged mucoids. The caudal pocket is incompletely formed. Lateral view. 15. Freshly emerged *C. corti* showing mucoid-

latter forces the conclusion that these accumulations in the suckers are true individual glands, formed *in situ*. Two pairs of the small elongate glands (Figs. 4, 30) follow the lateral margins of the buccal cavity, discharging at its dorso-lateral lips. Another, smaller pair is located mesiad, with ducts that follow the dorsum of the buccal cavity and empty along the dorsal lip near the mid-line. These glands are simpler than those in the body but similarly show a distinct tendency to branch. Their convolute ducts are filled with mucoid.

A similar pair of small glands develop at the same time on either side of the oral sucker (Fig. 4). They extend along the limiting membrane from the base of the oral sucker and empty laterally, near the anterior ends of the cercariae. Connections of these glands with the body glands were not observed at any time in their history.

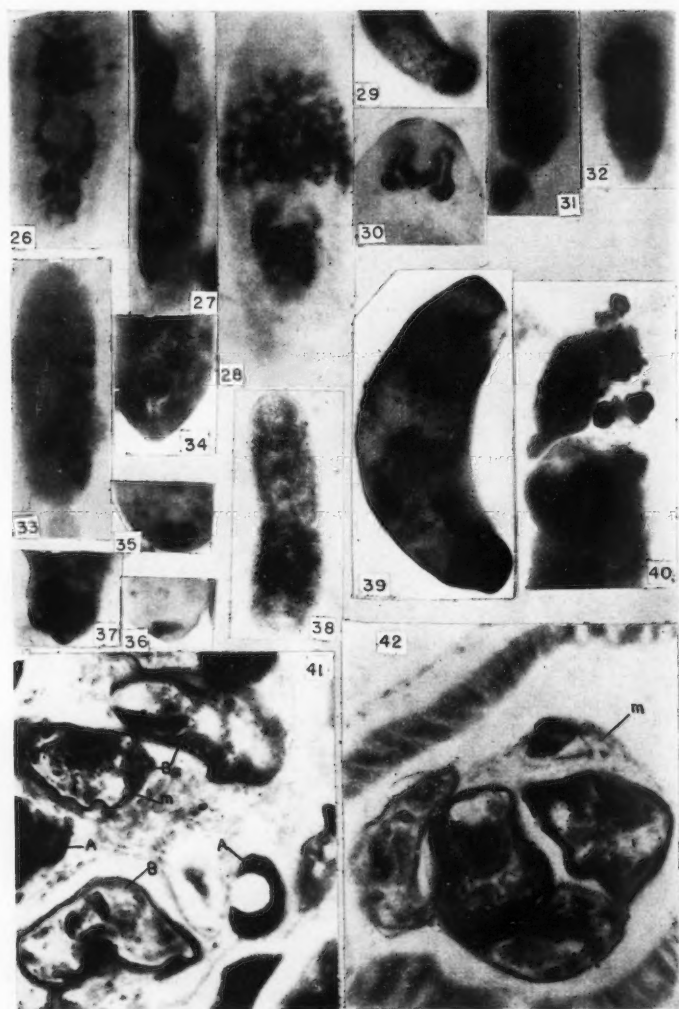
Despite excellent metachromatic differentiations of the specimens, it is difficult to determine the numbers of ventral mucoid glands because of the low visibility of their nuclei, the tendency of the glands to overlap shingle-like and their generally irregular morphology. The best possible determinations with the available material indicate six pairs of glands, three anterior and three pairs posterior to the acetabulum (Figs. 1-3, 6-8, 17-19, 24, 26). Glands from either the anterior or the posterior groups may partly encircle the acetabulum in the different species.

Ducts are also difficult to distinguish because of the irregular morphology of the glands. At best they are only intermittently and partly visible and could not be completely determined in *C. longistyla* and *M. typicus*. They extend on either side of the mid-ventral line into the restricted isthmus of tissue between the oral sucker and the cuticula from the most anterior pairs of glands in all of the cercariae (Figs. 2, 7, 13, 19, 24). From the second pair of glands they course antero-laterad and also terminate ventral to the oral sucker, and posterior to the mouth (Figs. 2, 13, 19). In no instance do these

filled caudal pockets and ventral groove. Dorsal view. 16-19. Developmental stages of *C. isocotylea*. 20. Non-emerged *C. isocotylea* showing the peripheral distribution of discharged mucoids and their ventral concentration. Posterior glands are incompletely discharged and caudal pocket is not visible. Ventral view. 21. Non-emerged *C. isocotylea* after discharge of all mucoid glands, showing mucoid at periphery, in buccal cavity and in caudal pockets, and its ventral concentration which is temporary. Lateral view. 22. Approximate frontal section of emerged *C. isocotylea* showing heavier posterior part of mucoid envelope and relation of excretory bladder to caudal pockets. 23, 24. Developmental stages of microcotylous cercaria from *G. livescens*. 25. Emerged specimen of cercaria from *G. livescens* showing mucoid retained in buccal cavity and acetabular pit.

ABBREVIATIONS: A—young cercaria, ac—acetabulum, B—pre-mature cercaria, b—buccal cavity, cp—caudal pocket, l—lateral mucoid accumulation, m—mucoid, mg—mucoid gland, os—oral sucker, pg—penetration gland, rf—reproductive fundment, sc—subcuticular metachromatic cell, sg—mucoid glands of the oral sucker, vg—ventral groove.

All drawings were made with the aid of a camera lucida from permanent preparations. One unit of the scale indicating magnification equals 0.01 mm. All photomicrographs (Figs. 26-42) are contact prints of negatives produced by the enlargement of positive color transparencies; their indicated magnifications are approximate. All figures except 22, 41, 42 are of whole mounts fixed in bichloride of mercury and stained in dilute, aqueous thionin. Fig. 22 is taken from a serial section of an emerged cercaria fixed in formalin and stained in thionin. Figs. 41, 42 are from serial sections of infected snails fixed in Bouin's and stained in thionin.



FIGURES 26-42

Figs. 26-28. Lateral (Fig. 27) and dorsal (Figs. 26, 28) views of developing *C. longistyla*, $\times 294$. 29. Emerged *C. longistyla*, posterior end, showing mucoids on the surface and in caudal pockets, $\times 294$. 30. Mucoid glands within the oral sucker of pre-emergent *C. longistyla*, $\times 294$. 31. Developing *A. corti*, $\times 294$. 32. Developing *C. isocotylea*, $\times 294$. 33. Lateral view of early *M. typicus*, $\times 294$. 34. Dorsal view of posterior

ducts attain the level of the mouth. These ducts in the cercaria from *G. livescens*, however, encircle the oral sucker, extending almost to the anterior tips of the cercariae (Fig. 24) where they most probably empty. The third pair of ducts appear to terminate at the margins of the cercariae, slightly anterior to the level of the bulk of their glands. The fourth pair of glands is one of the most difficult to delimit but, while there is some evidence among the available specimens that they continue to the dorso-lateral margins of the cercariae, they usually appear to terminate laterally and ventrally (Figs. 2, 7, 9, 13). The fifth and sixth pairs of glands (fifth only in the cercaria from *G. livescens*, v. *supra*) possess ducts to the posterior margins of the cercariae, with pores on either side of the base of the tail during initial development (Figs. 2, 7, 13, 19) but carried forward to a sub-terminal position during the late "migration" of the tail and the formation of the caudal pocket of *C. longistyla*, *C. isocotylea*, *A. corti* and *M. typicus*.

Development of the mucoid glands.—Numerous small, peripheral glands with relatively large nuclei and sparse cytoplasm are visible in many specimens of the non-irrigated xiphidiocercariae before tail differentiation occurs (Figs. 10, 12, 17). They are distributed over the entire surfaces of the cercariae and possess minute ducts to the surface. Their darkly metachromatic (purple-black) reaction to thionin is quite susceptible to the metachromatic-reversing effects of alcoholic dehydration so that their contents are only problematically mucoidal in nature. Similarly staining glands remain in normally emerged cercariae (Figs. 15) where they may form a complement of the cystogenous complex while other groups appear to be the precursors of the ventral mucoid glands and of the penetration glands. The latter contain definite, metachromatic mucoid secretions in their early development.

The mucoid glands proper can only occasionally be distinguished prior to active secretion. The metachromatic techniques employed definitely demonstrated mucoid in the glands at about the time of tail differentiation, subsequent to the formation of the oral sucker and acetabular primordia. Active secretion in these cells is indicated by the presence of irregular, fine droplets of highly metachromatic substances, closely adherent to their nuclei (Figs. 10, 11, 17). As secretion continues the small droplets enlarge and then coalesce (Figs. 6, 18) to form large, deeply metachromatic masses, eventually distending the cells and effectively masking the centers of secretion. The metachromatic reaction of these cells is highly resistant to the color reversing activity of alcoholic dehydration throughout their subsequent history. In different

portion of pre-emergent *M. typicus* showing the duct from the caudal pocket. 35-37. Caudal pockets of emerged *A. corti* showing a progressive loss of mucoid from the filled condition of freshly emerged cercariae (Fig. 37) to the depleted condition of older specimens (Figs. 35, 36). 38. Non-emerged *M. typicus*, ventral view, showing remaining posterior glands, the last to discharge, $\times 250$. 39. Emerged *C. isocotylea*, showing the peripheral distribution of mucoid and caudal pockets (compare with Figs. 35-37), $\times 294$. 40. Sporocyst of *M. typicus* showing contained mucoid globules, $\times 294$. 41. Section of snail through developing (A) and nearly mature, (B) *C. longistyla* showing differences in chromophilia and the mucoid envelope of the older cercariae. The original positive color transparency of this figure shows the diffuse metachromasy of surrounding snail tissues, $\times 294$. 42. Section of snail through a group of mature *C. isocotylea* in a duct of the digestive gland showing a portion of the surrounding mucoid film, demonstrable completely around this group in the original positive color transparency, $\times 634$.

species the glands appear first either anterior to the acetabulum (Figs. 10, 11, 16, 17), posterior to the acetabulum (Fig. 5) or almost simultaneously along the entire cercariae (Fig. 23). At maturity they almost completely fill the ventral surfaces of the cercariae (Figs. 2, 3, 8, 13, 24), overlapping one another markedly (Fig. 2) as their convoluted ducts fill variably with accumulations of secretion. The maximum development of the mucoid glands occurs as the cercariae approach maturity within their sporocysts.

The bodies of the glands undergo relative changes in position concurrent with the growth and development of the cercariae. The most marked of such changes is the shift of the masses of mucoid lateral to the acetabulum into those portions of the glands posterior or anterior to that organ in *C. isocotylea*, and the cercaria from *G. livescens*.

Discharge of the mucoid substances.—The small mucoid glands associated with the oral sucker of *C. longistyla* (Fig. 4) persist in freshly emerged cercariae but disappear from older individuals. The contents of these glands appear more dilute after the emergence of the cercariae possibly due to slight differences in the staining techniques used on the specimens but more probably indicating a progressive discharge of mucoid during and after the emergence of the cercariae.

All of the ventral mucoid glands discharge from the cercariae while the latter are still within their sporocysts. Occasionally, small flecks of mucoid are still present in specimens that have left the sporocysts, but are still within the tissues of the snail indicating that the cercariae are discharged from sporocysts at the time of mucoid discharge. A few specimens of the nearly mature cercariae retain portions of their post-acetabular complement of glands only (Figs. 9, 14, 20, 38) and in all cases the dilution of the mucoid in these remaining glands is evidence of their partial discharge. It is thus probable that the discharge of the entire complement is rapid and almost simultaneous.

Irregular masses of mucoid accumulate along the ventral surfaces of the cercariae as the glands begin to discharge (Figs. 14, 21) confirming the observations that the pores are ventral. These masses smooth out, forming a continuous layer or envelope over the entire bodies of the cercariae which is closely adherent to the cuticula (Fig. 28) and extends into the depths of the buccal cavity (Figs. 20, 25). In contrast to the other species in which only a thin film lines the cuticula of the buccal cavity (Fig. 21), the mouths of the cercariae from *G. livescens* appear to be filled with the substance thus serving as temporary storage organs (Fig. 25). Large deposits of the highly metachromatic secretions accumulate in the ventral grooves and fill the caudal pockets of the other cercariae.

Clusters of adhering mucoid globules are commonly present in the sporocysts of *M. typicus* (Fig. 40) even after all nearly mature cercariae have been discharged. The periphery of each globule appears denser than its central portion and is more highly metachromatic to thionin and toluidin blue. This can be seen in both serial section and whole mount preparations and does not appear to be a surface artifact. The vesicles do not become confluent, as might be expected, nor are immature cercariae or the walls of the sporocysts contaminated with the mucoid. The fundamental nature of the mucoid substances must be altered upon discharge, possibly by contact or combination

with materials present in sporocyst cavities. An increased density and a correlated decreased permeability of the surface film of the globules would explain these observations satisfactorily. Only minor strands of mucoid are visible in the sporocysts of *C. longistyla* but, similarly, there is no apparent contamination of immature cercariae and sporocyst tissues. A parallel reaction of their mucoid envelope would also explain its persistence around the cercariae despite their close contact with snail tissues during emergence migrations as well as the maintenance of its post-emergent stringy viscosity (*v. infra*).

A fine peripheral reticulum of mucoid material is present in tissues around migrating cercariae which might be attributed to the adhesion of mucoids to the snail tissues after a pronounced fixation shrinkage of the cercarial tissues. However, a wide area strongly metachromatic to toluidin blue, near aggregations of the cercariae, indicates that cercarial mucoids are lost during migration. Such dispersed mucoids are insufficient to mark the routes of individual members of the groups. Further groups of cercariae in the ducts of the digestive glands (Fig. 42) are surrounded by an area of diffusely metachromatic particles and fine strands of mucoids. Some of this material may stem from the epithelial cells of these ducts but at least part of the corona obviously derives from the cercariae themselves.

The caudal pockets of the cercariae are present but comparatively small prior to the discharge of the mucoid glands (Figs. 3, 13, 20) but they increase appreciably with that discharge (Figs. 14, 15, 21). Hussey (1941) similarly noted that the greatest development of the caudal pockets takes place late in the development of the cercariae. The influx of mucoid into the caudal pockets indicates that the pores of the glands posterior to the acetabulum are carried from their original positions at the posterior boundaries of the cercariae into the forming caudal pockets by the differential growth which results in the formation of the latter. Ducts of these glands (*v. supra*) can be traced only to the lips of the caudal pockets. Possibly the pressure of the secretions within the glands, and other pressures within maturing cercariae (see also Kruidenier, 1951), cannot overcome the barrier offered by the sharp recurving of the ducts from the glands along the restricted subcuticular tissues at the lips of the ventral groove and caudal pockets prior to final development.

The influx of mucoid into the caudal pockets and the compensatory enlargement of the pockets does not appreciably crowd adjacent tissues (Fig. 22). The evacuation of the massive mucoid glands from their bodies thus permits the rearrangement of cercarial tissues to accommodate the definitive, much enlarged caudal pockets. At this stage in development the caudal pockets and ventral grooves show the greatest accumulations of contained mucoid that are present at any time in the history of these cercariae. The shallow ventral groove of *M. typicus* is accentuated by the ventral flexure of the lateral margins of the body and the mucoid deposits are thicker in the elongate trough so formed posterior to the acetabulum. Similar cupping of the body posterior to the acetabulum is less marked in the other species studied here and does not result in the retention of marked mucoid accumulations although the mucoid envelope is always heavier around the posterior ends of the cercariae.

Definite losses of mucoid from the ventral groove occur during the migra-

tions of the cercariae through snail tissues or at the time of their emergence. The grooves of all individuals examined *en route* in the snail were filled with mucoid and, frequently, thick masses protruded between the tail and the overhanging tip of the body. These masses may indicate only an excessive formation of mucoid by the body glands and its subsequent overflow but, at any rate, massive accumulations of mucoid persist in the ventral grooves of all post-emergent individuals with the exception of the cercariae of *M. typicus*. With the same exception the caudal pockets of freshly emerged specimens are filled to capacity with mucoid.

Although the mucoid glands of *M. typicus* (Fig. 8) are as large as those of most of the species studied, the caudal pockets of the normally emerged cercariae of this species contain only minor peripheral deposits of mucoid substances (Fig. 34). The termination of the excretory duct into the enclosed caudal pocket of this species (*v. supra*) and the constant flow of excretory fluids through the caudal pockets proper would hasten the evacuation of the mucoids deposited therein. Only indirect evidence of such a flushing action with increased excretory activity is present. Sections through the caudal pockets of cercariae in sporocysts demonstrate a small, slit-like central cavity or open chamber, comparatively large amounts of enclosed mucoid, and the duct from the caudal pockets is usually occluded by masses of mucoid. Comparable whole mount specimens contain lesser amounts of enclosed mucoid; the unfilled central cavity of the caudal pockets is larger and the ducts are patent. In a few whole mounts a small, elongate plug of mucoid extends from the caudal tube into the ventral groove. The younger specimens in the identical preparations are frequently swollen abnormally, an indication that the saline solutions into which they were dissected were hypotonic, but the still open cavities within the caudal pockets and ducts demonstrate that this force is not responsible for the extensive evacuation of mucoids from the older cercariae.

A very few cercariae of *M. typicus* were observed in migration in the sectioned tissues of the snails. Their caudal ducts are occluded with mucoid and their caudal pockets contain relatively large amounts of the material. No more than a small residuum of mucoid is present in the caudal pockets of whole mounts made from cercariae collected as they emerged from snails under constant observation. Only minor deposits are present along the walls of the caudal pockets and tubes of serially sectioned, normally emerged specimens, and delicate strands of mucoid form occasional fine nets within these cavities.

The evidence that an influx of water into the tissues of emerged cercariae does occur is similar to that obtained in the studies of virgulate cercariae (Kruidenier, 1951). The cells of older, post-emergent cercariae are more vesicular and turgid; their nuclei are more widely separated; cell chromophilia is reduced indicating a dilution of the protoplasm; finally, the cercariae as a whole enlarge appreciably.

The only compensatory mechanism in the cercariae appears to be the excretory system. No visible progressive developmental changes occur in matured cercariae and there is no apparent food intake in the emerged cercariae. The obvious increase in muscular activity of emerging and emergent cercariae can

only deplete available energy reserves and add to the burden of the excretory system. Thus the only apparent difference between mature, pre-emergent and emerged cercariae is in the activity of their excretory systems which must adjust to the environment. The effects of hypotonicity are demonstrated by the occasional specimens among the cercariae dissected from snail tissues and/or sporocysts which show an extruding mucoid plug and the emptied caudal pockets and caudal tubes. Predictable isotonicity of cercarial tissues with intra-sporocyst fluids and their approximate isotonicity with snail tissues are substantiated by the full condition of caudal pockets and caudal ducts of cercariae in those environments. The normal emergence of cercariae from the snails into their next, "normal" aquatic environment must result in the increased activity of their protonephridial systems. This results in an increase in the amount of fluid emptied into the caudal pockets and tubes of *M. typicus*. The relatively empty caudal pocket system of emerged cercariae of this species thus indicates that the excretory activity is increased radically upon the emergence of the cercariae, and the mucoid is literally flushed from the caudal pockets and tubes.

As noted, the loss of mucoid from the caudal pockets of *C. longistyla*, *C. isocotylea*, and *A. corti* during emergence activities may be the normal loss due to the production of mucoids beyond the storage capacity of those cercariae. Little loss can be attributed to the excretory activity as the excretory ducts in those species empty independently into the ventral grooves (Fig. 22) and such activity would necessarily be indirect and minimal.

Discussion.—The general features of mucoid production and definitive distribution, quite similar in the armate, ornate and microcotylous cercariae studied, markedly parallels those processes in the virgulate xiphidiocercariae (Kruidenier, 1951). Differences in the numbers of glands developed in the several species are present and, possibly, might be expected in so large a group of trematodes. The provisions for the storage of the mucoid substances against future use are interesting, including, as they do, morphological variations of the oral sucker (virgulae) and of the posterior ends of the cercariae (caudal pockets) or the apparent utilization of non-specialized structures (the buccal cavity of the microcotylous cercaria from *G. livescens*). Mucoid glands are retained after emergence in only one of these species, *C. longistyla*, and in this instance only the exceptional, minor complement of glands associated with the oral sucker are so retained. The discharge of these glands results in an increase in the amount of mucoid retained at the anterior ends of the cercariae, however, and may be of definite value to them.

Several investigators have speculated concerning the nature of the glands of xiphidiocercariae. Faust (1917) described certain "stylet" or "salivary-mucin" glands that most probably include actual mucin glands. His terminology is somewhat confusing, apparently based on his belief that these glands discharge directly into the buccal cavity, are therefore salivary glands and must necessarily contain mucin because the salivary glands of vertebrates do. His substantiation for this belief is based on the discovery by LaRue (1917) that the ducts of certain metacercarial glands contain a metachromatic substance. Faust (1917) also termed the stylet of the cercariae a "mucoid" structure, illustrating his very general use of this terminology. Dubois (1929),

considering probably identical cells characteristic of the xiphidiocercariae, tentatively proposed that they might serve as special cystogenous glands. The glands are not limited to the xiphidiocercariae (Kruidenier, 1947) and their history has not yet demonstrated the use of their secretions in the formation of cysts.

As in virgulate cercariae (Kruidenier, 1951), the discharge of the mucoid glands of the non-virgulate species occurs at the approximate cessation of cercarial development within the snail. This must correlate with the changes which terminate cercarial adaptation to the snail to initiate the adaptations permitting invasion of and life in a definitely restricted series of second intermediate hosts. The interpolation of the mucoid layer between the cercariae and snail tissues cannot fail to further protect these organisms from the predictable effects of physiological imbalance during their stay in the snail tissues. The indicated surface reaction of intra-sporocyst mucoid globules observed in the studies of *M. typicus*, would prevent the rapid loss of surface mucoids, increasing their protective properties and preserving the stringy nature of the underlying coating.

It is apparent in all species that portions of the mucoids are dissipated from the cercariae during their sojourn in snail tissues possibly indicating the production of mucoids in excess of the capabilities of the cercariae to handle them. The losses, especially from the peripheral coat, may be due to the mechanical contacts of cercariae with snail tissues and may indicate that the mucoid functions to lubricate the migrations of the cercariae. Mucoids in snail tissues are more concentrated in the vicinity of groups of cercariae but they diffuse into surrounding tissues as well. This and the aura of diffuse mucoids and delicate mucoid strands around clusters of cercariae (*C. longistyla*) within the tubes of the digestive glands of the snail may indicate that mucoids are dispersed fortuitously but it also may indicate that mucoid dispersal is not necessarily lubricatory. The inhibiting effect of mucoids on digestive enzymes is known (Meyer, 1946) and partial saturation of surrounding snail tissues with these substances would appear to exert a distinct effect on enzyme concentration and effect around and on the cercariae.

Entangling strands that extend from the mucoid masses in their ventral grooves, demonstrable in preparations of emerged cercariae, explain the transition of the caudal pockets from large, cup-like cavities to narrow almost depleted slits. Such strands obviously serve in the fixation of the cercariae to various substrates and the extrusion of mucoid from caudal pockets thus supplements the expended ventral groove materials. The depleted caudal pockets of *C. isocotylet*, *A. corti* and *C. longistyla* (Fig. 36) resemble the pockets of immature cercariae of those species immediately prior to the discharge of their mucoid glands. Thus the form of the pockets of these mature emerged cercariae appears to be largely determined by the amount of mucoid which they receive and retain from the mucoid glands of the immature cercariae.

The mechanism of mucoid discharge from the caudal pockets is possibly complex but several factors appear probable. The strong contractions of the bodies of swimming cercariae are doubtless a contributing factor. Similarly the intra-tissue pressures caused by the imbibition of water from a decidedly hypotonic environment would force materials from the caudal pockets. The

flushing action of an increased excretory activity accompanying the increased water intake would contribute to the progressive, gradual discharge of the mucoids from the caudal pockets.

The mucoid envelope cannot fail to interpose a barrier against the necessarily hypotonic medium in which the emerged cercariae live, just as it also offers automatic protection to these cercariae from the effects of their own proteolytic enzymes during the act of penetration into second intermediate hosts. In addition, the peripheral envelope is frequently thicker at the ends of their bodies and the lashing motions of the cercariae while swimming favors contact of these thickened areas with objects in their paths. It is occasionally possible to drag individual cercariae through the water by means of slender strands formed by touching the swimming cercariae sharply with a fine needle, demonstrating the value of the peripheral envelope in attaching cercariae to substrates.

McMullen (1935) noted that the cercariae of *M. typicus* characteristically tend to gather into entangled wriggling groups upon their emergence from the snail. Other species (McMullen, 1935, also confirmed in these studies) do not commonly so aggregate. He attributed this to an active burrowing of these cercariae into masses of snail mucus. Such mucus is available to all species of cercariae so that this explanation implies a special tropism for *M. typicus*, a concept difficult to accept.

The more anterior attachment of the tail of *M. typicus* ensures that its very strong swimming motions are translated more into a vigorous lashing of the body and less into forward progression in contrast to the other cercariae observed. In addition the more complete discharge of mucoid from the caudal pockets and caudal ducts upon contact with the free environment may aid in the entanglements observed. The concurrent emergence of groups of these cercariae and the discharge of their accumulated mucus into that always present at the surfaces of snails favors an entanglement of the cercariae which their own swimming motions would further. The advantage of such entanglements in ensuring broader contacts with the second intermediate hosts or in holding groups to the substrates in flowing water is obvious but similar activities in natural habitats (as pointed out by McMullen, 1935) are highly speculative.

Summary.—A series of homologous, ventral, bilaterally symmetrical glands is demonstrated in five species of cercariae representing the major groups of non-virgulate xiphidiocercariae. The decidedly metachromatic reaction of the unicellular glands to thionin and toluidin blue is strong presumptive evidence of their mucoprotein or mucopolysaccharide nature. The entire development and discharge of the glands occurs in pre-emergent, immature cercariae. The storage of their secretions in either the specialized caudal pockets or the buccal cavities of the various species indicates the probable importance of this substance in the economy of the parasites. Despite variations in the numbers and complexity of the glands, marked parallelisms in development, distribution and fate indicate that they are homologous with similar glands in virgulate xiphidiocercariae (Kruidenier, 1951).

Observations of living, normally emerged cercariae demonstrate the use of a peripheral film and stored mucoid derived from the glands in attaching cercariae to substrates. Permanent preparations of these cercariae confirm

these observations. An inferred protection of the cercariae from deleterious effects of their free aquatic environment and from pre- and post-emergent mimical host activities as well as the lubrication of migratory movements within hosts are substantiated by analysis of their life histories, the application of recognized general properties of mucoid substances and studies of migrant cercariae *in situ*.

REFERENCES

- CORT, W. W. 1915—Some North American larval trematodes. Ill. Biol. Mon. 1(4):7-86.
- CRAWFORD, W. W. 1937—A further contribution to the life history of *Alloglossidium corti* (Lamont), with special reference to dragonfly naiads as second intermediate hosts. J. Parasit. 23:389-399.
- DUBOIS, G. 1929—Les cercaires de la région de Neuchâtel. Bull. Soc. Neuchât. d. Sci. Nat. 53:1-177.
- FAUST, E. C. 1917—Life history studies on Montana trematodes. Ill. Biol. Mon. 4(1):7-120.
- 1918—Studies on Illinois cercariae. J. Parasit. 4:93-110.
- HUSSEY, K. L. 1941—Comparative embryological development of the excretory system in digenetic trematodes. Trans. Amer. Micr. Soc. 60:171-210.
- KRUIDENIER, F. J. 1947—Mucin in developing digenetic trematodes. J. Parasit. 33(6, 2 suppl.):36(abstr.)
- 1951—The formation and function of mucoids in virgulate cercariae, including a study of the virgula organ. Amer. Midl. Nat. 46(3):660-683.
- LAMONT, M. E. 1921—Two new parasitic flatworms. Occ. Papers Mus. Zool. Univ. Mich. 93:1-6.
- LARUE, G. R. 1917—Two new larval trematodes from *Thamnophis marciana* and *Thamnophis egeri*. Ibid. 35:1-14.
- LEBOUR, M. U. 1911—A review of British marine cercariae. Parasitology 4:416-456.
- LEUCKART, R. 1886-1901—Die Parasiten des Menschen und die von ihnen herrührenden Krankheiten. Band 1, 2. Abt. 771. Leipsig.
- LISON, L. 1935—La signification histochemique de la metachromasie. Comptes Rend. Sci. de la Soc. de Biol. 118-821.
- LÜHE, M. 1909—Parasitische Plattwürmer. I Trematodes. Süßwasserfauna Deutschlands. Heft 17. Jena:1-215.
- MCCOY, O. R. 1929—Life history studies on trematodes from Missouri. J. Parasit. 14:207-228.
- 1929a—Further studies on marine trematodes. Carnegie Inst. Year Book 28:290-292.
- McMULLEN, D. B. 1935—The life history and classification of two Alloeocreadiid-like Plagiorchids from fish. J. Parasit. 21:369-380.
- 1937—A discussion of the taxonomy of the family Plagiorchidae Lühe, 1901, and related trematodes. J. Parasit. 23:244-256.
- MEYER, K. 1946—Currents in Biochemical Research. Interscience publication.
- MILLER, E. L. 1935—Studies on North American cercariae. Ibid. 21:244-254.
- 1936—Studies on North American cercariae. Ill. Biol. Mon. 14:46-78.
- SCHWARTZ, W. 1886—Die Postembryonale Entwicklung der Trematoden. Zeit. Wissen. Zool. 43:41-86.
- SEWELL, R. B. S. 1922—Cercariae Indicae. Ind. Jour. Med. Res. Suppl. 10:1-373.
- 1931—Cercariae nicobaricae. Ind. Jour. Med. Res. 18:785-806.

A New Type of Metacercarial Cyst of the Genus *Apophallus*, from the Perch, *Perca flavescens*, in Minnesota*

Bruce H. Warren

University of Minnesota, St. Paul

A new type of cyst containing a metacercaria with the characters of the genus *Apophallus*, but differing considerably from any *Apophallus* cysts previously described, was found imbedded in the musculature of the common perch, *Perca flavescens*, in northern Minnesota. These cysts were present in all of 30 perch examined from Lake Itasca and in a single large perch, about 12 inches in length, examined from Leech Lake. The fish from the first lake varied from two to eight inches in length. A few cysts were also found in one of a number of minnows, *Notropis* sp., from Lake Itasca, but they were not found in *Fundulus diaphanus*, *Esox lucius*, *Stizostedion vitreum* or *Ambloplites rupestris*, although several of each were examined. Following is a description of the cysts and of the contained metacercaria, for which the name *Apophallus itascensis* is proposed, a report of negative experimental feedings, and a discussion of the relation of this parasite to other species of the genus. Grateful acknowledgement is made of the assistance given by Dr. Asa C. Chandler in the course of this study.

THE CYST

The cyst of *A. itascensis* usually consists of three layers. The inner layer or primary cyst tightly surrounds the metacercaria and is oblong in shape. It is composed of a strong hyaline substance probably secreted by the parasite. Because of the great difficulty met in removing the secondary cyst, only two of these inner cysts were obtained intact for accurate measurement. One of these measured $323\mu \times 300\mu$ and the other $390\mu \times 335\mu$. Measurements of several other primary cysts came close to this range, though the measurements could not be as accurately made.

The secondary cyst has a very peculiar shape, looking not unlike a miniature balloon tire (fig. 1). Its general shape is moderately flattened and biconcave. The upper and lower aspects of the cyst are greatly thinned immediately above and below the contained primary cyst leaving a tire-like ring of hard, translucent, amorphous material similar in character to the substance of the lens of an eye, but harder and more glassy. The size is variable; measurements of 50 secondary cysts gave a range from 345 to 630μ in depth (av. 440), from 398 to 1066μ in width (av. 674) and from 503 to 1170μ in length (av. 794). While the above general shape is characteristic, some exceptions were encountered in which one cyst was elongated and cylindrical with no concavities, and several were angular in shape.

Because of its hardness it is almost impossible to dissect this cyst to liberate the primary cyst. When ingested by a suitable host a round escape hole is digested for the metacercaria from the thin concave areas overlying the primary cyst.

A third layer usually surrounds the secondary cyst. This consists of host connective tissue and black pigment. When this layer is present the cysts are much easier to find in the flesh of the fish. Sometimes the pigment is present in small amounts, giving the cyst a speckled appearance.

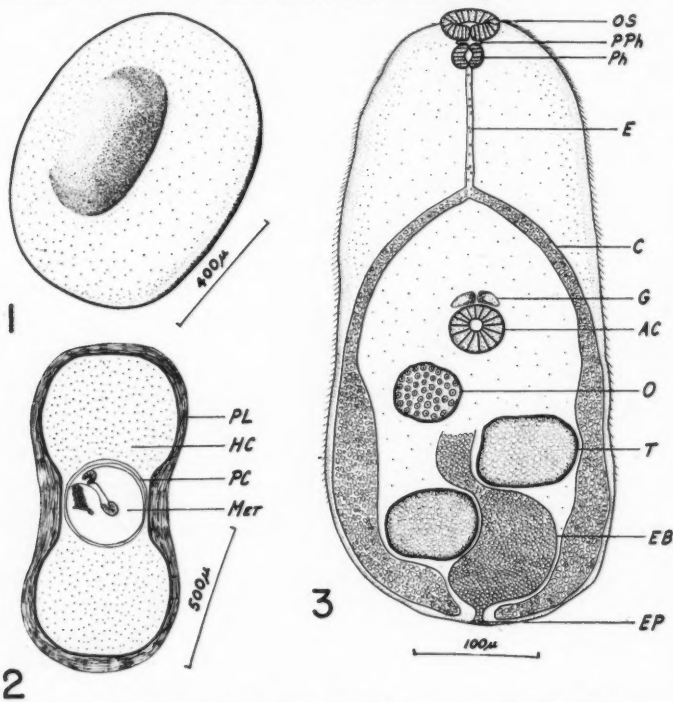
THE METACERCARIA

Due to the great difficulty in removing the secondary cyst, few metacercariae were obtained by mechanical means which were not damaged. Artificial digestion was tried but proved unsuccessful. A total of nineteen metacercariae were studied, of which nine

* Contribution from the University of Minnesota Biological Station, Lake Itasca, Minnesota.

were removed mechanically from the cysts (seven were slightly damaged), and ten were taken from the ileum of a cat which had been fed cysts.

The metacercaria is at an advanced stage of development in its cyst before ingestion by the definitive host. As is the case with other species of *Apophallus*, it is virtually a young adult. The testes and ovary are well formed. The gonotyl is present and the body of the worm itself approaches the size of some adult species of *Apophallus*. However, the vitellaria, one of the principal characters used in separating the species in this genus, are not developed, so it is impossible to differentiate this parasite with certainty from some of the known species by the features of the metacercaria, though the characters of the cyst are very distinctive. Lyster (1940) used the gonotyl as a character to separate the species of *Apophallus*, but Miller (1941) concluded that the shape of the gonotyl was too variable to be of value. This conclusion has been substantiated in the present study, in which the gonotyls were observed to have many different shapes.



Figs. 1-3.—1. Metacercarial cyst of *Apophallus itascensis*, showing "balloon tire" shape; 2. Optical section of cyst of *A. itascensis*, showing shape and relative size of primary or parasite cyst, closely investing folded metacercaria, and two parts of secondary or host cyst, the inner glassy one (stippled) very thick laterally, and the outer one of loose connective tissue with black pigment cells; 3. Metacercaria of *A. itascensis*, freed from cyst.

ABBREVIATIONS: AC—acetabulum, C—cecum, E—esophagus, EB—excretory bladder, EP—excretory pore, G—gonotyl, HC—host cyst, Met—metacercaria, O—ovary, OS—oral sucker, PC—parasite cyst, Ph—pharynx, PL—pigment layer, PPh—prepharynx, T—testis.

Description of Metacercaria.—The body contour varies from oval to elongate pyriform depending on the extension of the anterior end. In fixed specimens the oval form is prevalent. The body ranges in length from 405 to 903 μ and in breadth from 195 to 300 μ , being two to three times as long as wide in the oval form and about four times longer than wide when pyriform. Numerous small spines arranged in diagonal rows arise from the cuticle in the anterior half of the body but only few can be discerned posteriorly.

The oral sucker is oval and measures 36 to 41 μ long and 39 to 60 μ wide. A short prepharynx is present between the oral sucker and the muscular pharynx and is best seen on unstained live specimens. The pharynx ranges in length from 31 to 42 μ and in breadth from 24 to 26 μ . The esophagus is very long, extending about a third of the body length in oval specimens and up to one half the body length in those of pyriform shape. The ceca extend to the posterior end of the body, following the contour of the body until they almost touch the excretory bladder in the median field. This latter organ is expanded posteriorly, narrowing as it twists to pass between the testes and then twisting again as it passes forward medial to the ovary. Up to the level of the ovary it is filled with refractile granules. It could not be traced anterior to the level of the ovary.

The acetabulum is round and measures 37 to 48 μ in diameter. The gonotyl apparatus consists of two arched, pyriform structures immediately anterior to the acetabulum.

The ovary lies on the right side of the body diagonally and posteriorly from the acetabulum. It is usually round, ranging from 51 to 73 μ in diameter.

The two testes lie obliquely from each other in the posterior third of the body. The anterior testis lies on the left side of the body and the posterior testis on the right. They vary greatly in shape and may be round, oval or angular, but are usually wider than long. The testes measure from 73 to 95 μ in length and 93 to 119 μ in breadth.

The finer details of the reproductive system can not be seen in the metacercaria. As has previously been mentioned vitellaria are entirely absent.

EXPERIMENTAL FEEDINGS

The cysts of *A. itascensis* from the flesh of perch were fed to six kittens and to four chicks in the hope that the worms might develop to maturity and be identifiable. The chicks were fed from 25 to 32 cysts each; one was examined after 10 days and three after 24 hours, but no worms were found in any of them. Five of the six kittens were fed 43, 50, 24, 32, and 6 cysts, respectively, and were examined, 4, 4, 9, 11, and 27 days later, all with negative results. The sixth kitten was fed 135 cysts and examined 12 hours later. Ten worms were found in the ileum, but they did not appear very active and were probably on their way out of the intestine. 133 of the 135 cysts fed this kitten were recovered in the large intestine. In those from which the metacercariae had been liberated the concave area of the cyst had been digested away. The diameter of this aperture was approximately 120 μ .

It is unusual that cysts found in perch did not infect kittens even when fresh cysts were fed in quite large numbers. The adults of the various species of *Apophallus* have nearly all been infective to cats.

DISCUSSION

There has been considerable confusion concerning the genus *Apophallus* and the species assigned to it. The situation was reviewed by Lyster (1940), who recognized three closely related species of *Apophallus* as occurring in Canada and the Eastern United States: *A. venustus* (Ransom, 1920), *A. brevis* (Ransom, 1920), and *A. imperator* (Lyster, 1940). Miller (1941), however, reduced Lyster's *A. imperator* of loons in Eastern Canada to synonymy with *A. brevis*, which was described from a gull, *Larus delawarensis*, in Washington, D. C. *A. venustus* has been reported from the dog, cat, Alaskan fox, harbor seal, and great blue heron as definitive hosts. Lyster obtained experi-

mental infections with his "*A. imperator*" in cats and pigeons. *A. donicus* (Skrjabin and Lindtrop, 1919), a species found in many kinds of birds and mammals in Europe was reported by Price (1932) in rats in Virginia. Price (1931) considered *A. venustus* to be a synonym of this species, and Douglas (1951) referred some specimens he found in a dog in California to *A. donicus*. On the other hand, Cameron (1936) and Lyster (1940) considered *A. venustus* a distinct species. This question is one which the writer is not in a position to clarify, but the wide host range of *A. donicus* in Europe, including Holarctic mammals and migratory birds, would make its occurrence in the North American continent not improbable. In any case, the metacercarial cysts of *A. donicus* as described by Ciurea (1928), found superficially on the fish as are those of *A. venustus*, differ greatly from those of *A. itascensis*. Van Cleave and Mueller (1932) described *A. americanus* from two immature specimens, one from the intestine of a wall-eyed pike, *Stizostedion vitreum*, and the other from the intestine of a yellow perch, *Perca flavescens*. They felt these were accidental infections in which the worms would probably not have matured. Another North American species of the genus, *A. crami* Price (1931), has thus far been reported only from the California gull, *Larus californicus*, at Klamath Falls, Oregon, and its metacercaria has not been found.

The metacercarial cyst of *Apophallus* here described differs strikingly from those of either *A. venustus* or *A. brevis* in shape, structure, size, host and anatomical distribution. The cysts of both of the latter species are of orthodox shape, the secondary or host cyst being oval in outline and composed of dense fibrous tissue, quite in contrast to the biconcave balloon-tire shaped cysts here described. Cameron (1945) reported the largest observed cyst of *A. venustus* to $250 \times 175\mu$ and of *A. brevis* $231 \times 154\mu$, whereas the parasite cysts here described measure up to $390 \times 335\mu$. The cysts of *A. venustus* have been found in 13 different species of fish of many different families. They are unpigmented and occur in the musculature at the base of the dorsal and anal fins, and less frequently of the other fins, but not elsewhere in the cuticle or musculature. The cysts of *A. brevis* have been found naturally only in the speckled trout, *Salvelinus fontinalis*, although the brown trout, *Salmo fario*, has been experimentally infected; rainbow and lake trout have proved refractory. They form black spots and are widely distributed in the skin, fins and head of the fish. The cysts described in this paper have so far been found only in perch with the exception of one record in a minnow, *Notropis* sp. They produce a moderate melanistic reaction, and are found deeply imbedded in the musculature, particularly of the back.

The peculiar characters of shape, structure, size, and host relations of this metacercarial cyst appear to warrant its recognition as a distinct species, as has been done above. The peculiarities are not likely to be due to the effects of living in a strange host, for *A. venustus* cysts have not been reported to show any peculiarities of development or location in such widely different hosts as bowfins, catfish, bass and perch. It is therefore impossible to consider this parasite as specifically identical with either *A. venustus* or *A. brevis*, found in northern and eastern North America, and it does not appear to be identifiable with *A. crami* because of anatomical differences shown by the

young worms (body shape and bifurcation of the gut). The body shape of *A. itascensis* varies from oval to pyriform, depending on the expansion of the anterior portion of the body, and the body is never found constricted whereas the body of *A. crami* is constricted on both sides in the region between the acetabulum and the intestinal bifurcation. The esophagus of *A. itascensis* bifurcates about one-third to one-half the body length while that of *A. crami* bifurcates about one-fifth the body length from the anterior end. *A. itascensis* most nearly resembles *A. americanus*. As *A. americanus* was described on the basis of only two immature worms, however, it is difficult to ascertain how nearly the average measurements of the two species would coincide. *A. americanus* appears to be a somewhat larger worm being 900 to 1020μ in length while *A. itascensis* varies from 405 to 903μ with an average length of 736μ . *A. americanus* does not evidence a prepharynx while *A. itascensis* does. The gonotyl apparatus of the latter species is clearly seen in all specimens while it is undiscernible in the two specimens of *A. americanus*. The two species are similar in that the esophagus is one-half the body length in *A. americanus* and one-third to one-half in *A. itascensis*. Testicular arrangement is also similar in the two species although no measurements are given for the testes of *A. americanus*. Further experimental evidence is necessary to determine the relationship of these two species to each other.

The only adult specimens of *Apophallus* thus far obtained from hosts examined at the University of Minnesota Biological Station were a few specimens obtained from a loon from Lake Itasca and identified to genus but not to species by Dr. A. C. Chandler. These specimens were removed by students and are not now available. When more aquatic birds become available for parasitological examination in this area, the definitive host for this new species of *Apophallus* will probably be found.

REFERENCES

- CAMERON, T. W. M. 1936-1937—Studies on the heterophyid trematode, *Apophallus venustus* (Ransom, 1920), in Canada. Canad. Jour. Res. D 14:59-69; 15:38-51, 275. Parts I-III.
- 1945—Fish-carried parasites in Canada. Canad. Jour. Comp. Med. 9:245-254, 283-286, 302-311.
- CIUREA, I. 1928—*Rossicotrema donicum* Skrjabin et Lindtrop et sa metacercarie. Arch. Roumaines Path. Exper. Microbiol. 1:531-540.
- DOUGLAS, J. R. 1951—New Parasite Records from California Dogs. Cornell Veterinarian 41(4):342-346.
- LYSTER, L. L. 1940—*Apophallus imperator* sp. nov., a heterophyid encysted in trout, with a contribution to its life history. Canad. Jour. Res. D 18:106-121.
- MILLER, M. J. 1941—The life history of *Apophallus brevis* Ransom 1920. J. Parasit. 27, Suppl., 12.
- 1942—Black spot disease of speckled trout. Revue Canadienne de Biologie 1(4):464-471.
- 1946—The cercaria of *Apophallus brevis*. Canad. Jour. Res. D 24:27-29.
- PRICE, E. W. 1931—A new species of trematode of the family Heterophyidae, with a note on the genus *Apophallus* and related genera. Proc. U. S. Nat. Mus. 79(17):1-6.
- 1932—Society Proceedings. Helminth. Soc. Wash. J. Parasit. 18:55.
- RANSOM, B. H. 1920—Synopsis of the trematode family Heterophyidae with descriptions of a new genus and five new species. Proc. U. S. Nat. Mus. 57:527-573.
- VAN CLEAVE, H. J. AND J. F. MUELLER 1932—Parasites of Oneida Lake Fishes. Roos. Wild Life Ann. 3:33-35.

A Study of the Effects of Black and Yellow Grubs on *Lepomis cyanellus* and *L. humilis* in a Natural Environment

Thomas Ralph Rabideau and J. Teague Self

University of Oklahoma, Norman, and University of
Oklahoma Biological Station, Lake Texoma

Questions concerning the effects of parasitism on fish have stimulated considerable investigation; whether parasites damage their hosts to any appreciable extent seems to depend on a variety of conditions. Works dealing with this problem have been varied in nature and are too numerous for a complete review in this paper. Certain investigations (Van Oosten 1944; Elliot and Russert 1949) have indicated that parasites are of minor importance in fixing the standards of growth in an entire population. There are records, however, of populations having been damaged by heavy parasitism (Fasten 1922; Essex and Hunter 1926; Hubbs 1927; Reighard 1929; Cross 1938; Venard 1940; Fantham and Porter 1947). In certain instances, it has been shown that the reproductive capacity, at least, is impaired (Reighard 1929; Hunninen 1935; Hunter 1942). Experimentally, it has been demonstrated that tissue parasites especially may be a cause of stunting or loss of weight and sometimes death where infections are heavy. Noteworthy among works of this type are those of Krull (1934) and Hunter and Hunter (1938).

The work reported here is based on a study made during the fall of 1949, on a mixed population of *Lepomis cyanellus* and *L. humilis* taken from the Little River where it crosses the south campus of the University of Oklahoma in Norman. This population of fish was chosen for study because it represented a condition of overpopulation and stunting, as well as heavy parasitism. The fish were concentrated in small holes along the stream and were heavily parasitized by the strigeid metacercariae, commonly called "black grubs" and, less heavily, by yellow grubs of *Clinostomum marginatum*. This offered an opportunity to study relations between the general well-being of the fish, or K factor, and parasitism under natural conditions.

The fish were poisoned with rotenone. Upon collection, they were classified and weighed; standard length was determined and scale samples were taken for age determinations. Specimens were preserved in alcohol for future study of growth. A total of 341 fish were selected for study. Of these 203 were *Lepomis cyanellus* and 138 were *L. humilis*. They were separated into age groups as revealed by scale readings, and the K factor determined for each specimen.

Determinations and counting of the grubs in the muscles were made by examining longitudinal slices of the muscle tissues over a light. All other organs were dissected for cysts.

The fish were divided into five-millimeter groups within each age group, the age being expressed as the year in which they lived when collected. Growth was determined as the percentage of total growth in the last year,

as shown by scale readings. Data were charted separately for the two species of fish, as well as for the total group.

TABLE 1.—Grub infestations in *Lepomis cyanellus* and *L. humilis*
Lepomis cyanellus

Age	No. of hosts	Grubs			
		Black		Yellow	
		Total	Aver.	Total	Aver.
1	20	141	7.05	0	0
2	50	5,235	104.7	17	0.34
3	118	21,658	183.5	82	0.69
4	15	8,483	565.5	7	0.46
	203	35,517	215.19	106	0.37

Lepomis humilis

Age	No. of hosts	Grubs			
		Black		Yellow	
		Total	Aver.	Total	Aver.
1	38	3	0.078	0	0
2	42	529	12.59	40	0.95
3	58	1,746	30.1	90	1.55
	138	2,278	14.26	130	0.83

All fish

Age	No. of hosts	Grubs			
		Black		Yellow	
		Total	Aver.	Total	Aver.
1	58	144	2.48	0	0
2	92	5,764	62.65	57	0.62
3	176	23,404	132.97	172	0.98
4	15	8,483	565.5	7	0.46
	341	37,795	192.17	236	0.51

RESULTS

Table 1 shows the number of each species of fish examined in each age group, the number infected, the total number of grubs and the average number of grubs observed. The table shows a high rate of infection by the black grub and a relatively low rate by *Clinostomum marginatum*. As is shown in figure 1, the rate of infection increased with age, indicating that infection is cumulative. No correlation was found between the length of the host, within any age group, and rate of infection by *Clinostomum marginatum*. Infection by black grubs was shown to increase with the length of hosts within age groups.

The coefficient of condition, or K factor, as expressed by fishery biolo-

gists (Elliott and Russert, 1949), was then employed in an attempt to establish a correlation between the K factor and the rate of parasitism by all grubs. The results are shown in figure 2. Where the number of parasites in each host is plotted against its K factor, it is seen that there is no apparent correlation between the K factor of the host and the number of grubs parasitizing. Note that the fish with extremely heavy infections fall within the K factor range occupied by the largest number of fish with low rates of infection.

DISCUSSION AND CONCLUSIONS

The results, presented in this paper, are quite similar to those of Elliot and Russert (1949), who found no correlation between the K factor of yellow perch and heavy infections by grubs of *Clinostomum marginatum*. It is now pertinent to examine the technique used, as a valid means of determining the relation of parasitism to the conditions of a population of fish. As data accumulate, it becomes convincing that the effects of parasitism vary considerably. It is doubtful, also, if the K factor can

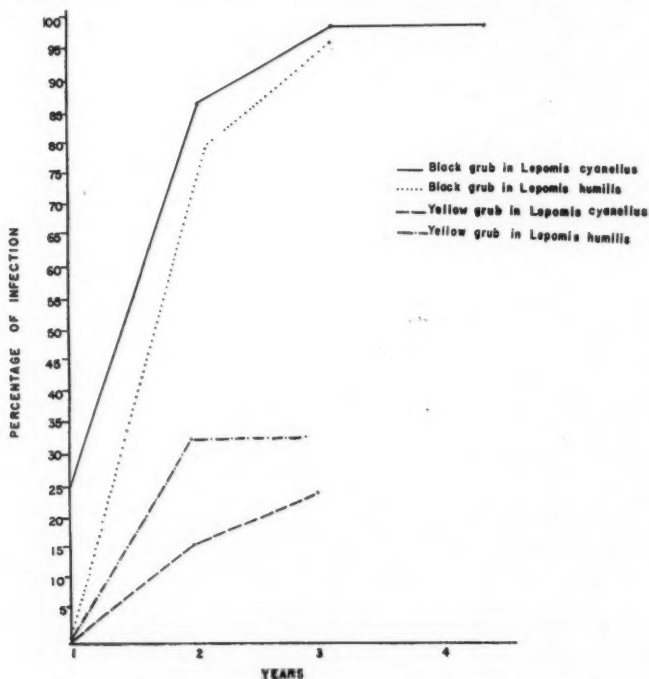


Fig. 1.—Percentage of infestation of 1.4 yr. old *Lepomis cyanellus* and *L. humilis* by black and yellow grubs

be used effectively as an indication of the damage done by parasites on the host. This factor may be used to show the influence of crowding, and other conditions, and the ecological factors involved may, also, influence the degree of parasitism. One would not expect, however, that factors such as overpopulation which would influence both K factor and parasitism would necessarily give an independent correlation between K factor and parasitism. The relationship between the latter two factors could be established only under carefully controlled conditions. It is the opinion of the authors, therefore, that the technique employed cannot be used in natural situations as a means of determining the effects of parasites on fish hosts.

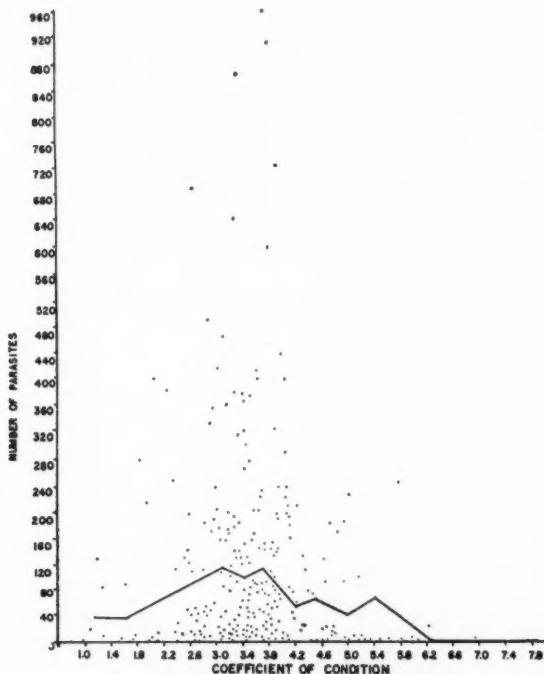


Fig. 2.—Parasitism by black grub plotted against coefficient of condition for all 1-4 yr. old fish

REFERENCES

- CROSS, SAMUEL X. 1938—A study of fish parasite relationships in the Trout Lake region of Wisconsin. Trans. Wis. Acad. Sci. Arts and Letters 31:439-456.
- ELLIOTT, A. M. AND L. R. RUSSERT 1949—Some conditions characteristic of yellow perch population heavily parasitized by *Clinostomum marginatum*. J. Parasit. 35:183-190.
- ESSEX, H. E. AND G. W. HUNTER III 1926—A biological study of fish parasites from the central states. Trans. Ill. St. Acad. Sci. 19:151-181.
- FANTHAM, H. B. AND ANNIE PORTER 1947—The parasitic fauna of vertebrates in certain Canadian fresh waters, with some remarks on their ecology, structure and importance. Proc. Zool. Soc. London 117(4):609-649.
- FASTEN, N. 1922—The tapeworm infection in Washington trout and its related biological problems. Amer. Nat. 56:439-447.
- HUBBS, C. L., 1927—The related effects of a parasite on a fish. J. Parasit. 14:75-84.
- HUNNINEN, A. W. 1935—Studies of the fish parasites in the Delaware and Susquehanna watersheds. Supp. 25th Ann. Rept. N. Y. St. Conserv. Dept. No. X. Biol. Surv. Delaware and Susquehanna watersheds. Pp. 237-245.
- HUNTER, GEO. W. III 1942—Studies on the parasites of fresh-water fishes of Connecticut. Conn. Geol. and Nat. Hist. Survey Bull. 63:228-288.
- AND WANDA S. HUNTER 1938—Studies on host reactions to larval parasites I. The effect on weight. J. Parasit. 24(6):477-481.
- KRULL, W. H. 1934—*Cercaria bessiae* Cort and Brooks, 1928, an injurious parasite of fish. Copeia 1934(2):69-73.
- REIGHARD, J. 1929—A biological examination of Loon Lake, Gogebic County, Michigan, with suggestions for increasing its yield of small mouth bass (*Micropterus dolomieu*). Papers Mich. Acad. Sci. Arts and Letters 10:589-612.
- VAN OOSTEN, J. 1944—Factors influencing the growth of fish. Trans. Ninth N. Amer. Wild Life Conference. Pp. 177-183.
- VENARD, C. E. 1940—Studies on parasites of Reelfoot Lake fish I. Parasites of the large-mouthed black bass, *Huro salmoides* (Lacépède). Rep. Reelfoot Lake Biol. Sta. 4:43-63.

An Ecological Study of the Helminth Fauna of Macgillivray's Seaside Sparrow, *Ammospiza maritima macgillivrayi* (Audubon)

Wanda Sanborn Hunter
Duke University, Durham, N. C.

Thomas L. Quay
North Carolina State College, Raleigh

Macgillivray's seaside sparrow, *Ammospiza maritima macgillivrayi* (Audubon) is the most abundant and widespread nesting bird in the salt marshes within a several mile radius of the Duke University Marine Laboratory at Beaufort, N. C. A "land" bird confined to a distinct maritime habitat, it provides an interesting host for parasitological studies. During a three-year period (1949-51), 100 seaside sparrows were examined. Comparisons of parasites from both adult and immature birds from two types of environments were made. All worms recorded from the hosts constitute new host records.

During the winter months, the seaside sparrows of this subspecies are absent from the Beaufort region, but the migration of adults into the area begins in late March. Most of the nesting population is present by mid-April and by June nesting is in full force, all pairs having either eggs or young in nests or feeding young out of nests. Adults and young leave this area during August and early September, and any of this subspecies to be found later in the fall are believed to be en route South from more northern habitats.

The local habitats from which the seaside sparrows were taken fall clearly into two categories, the rising shore or driftline type and the flat or non-driftline type.

ENVIRONMENT I

Rising shore or driftline type.—A driftline of one to twenty feet wide, depending on slope and configuration of the shore, marks the limits of the highest tides and is above the average high tide mark. *Spartina alterniflora* is the only plant in the intertidal zone. The bottom is usually soft black mud and peat. A beach of mixed sand and mud, exposed at low tide, is heavily populated with fiddler crabs, primarily *Uca pugilator*, common mud-flat snails, *Nassarius obsoleta*, and various polychaete worms. Directly behind the driftline, a grass complex, with *Spartina patens* dominating, forms a supratidal zone which extends to the dunes covered with sea oats, *Uniola paniculata*.

1 A contribution from the Duke University Marine Laboratory, Beaufort, N. C., supported by grants to the senior author from the Carnegie Research Fund and the Duke University Research Council. The assistance of Dr. Winona B. Vernberg is gratefully acknowledged.

ENVIRONMENT II

Flat or non-drift line type.—This environment differs from type I in that there is no driftline to form a clear-cut separation between the intertidal and supratidal zones, and no exposed "sandy" beach on the seaward side of the *S. alterniflora*. The height of the water table affects the distribution of the plant communities. Differences in altitude of only a few inches over the flat land influence species composition. *S. alterniflora* grows where salt or brackish water surrounds the roots at high tide. *S. patens* and plants associated with it occur where the bases of the plants are not usually covered with salt water. *Juncus roemerianus* is found only in this second environment, occurring throughout the area in clumps 5 to 30 feet across. The other species of plants grow around and in the edges of these clumps in ground of soft black mud and peat. *Uca pugnax* and *U. minor* are more abundant than *U. pugilator*, but compared to environment I there is apparently less variety of other marine life. Insects and terrestrial animals are more prevalent.

Macgillivray's seaside sparrows are equally numerous in either type of environment. Nests are placed throughout the *S. patens* complexes of both environments, and some in the edges of the *Juncus* clumps in II. The birds feed on both terrestrial and marine forms in all parts of their overall habitats, even entering shallow pools on the exposed beaches of the intertidal zone.

Environment I is referred to as "sandy" because of the exposed sandy-mud beach at low tide. Environment II is called "muddy" because of the lack of these exposed beaches and the deep mud of the marshes. Three distinct local areas served as collecting stations in the "sandy" environment, and six in the "muddy." Forty-one birds from environment I were examined and 59 from environment II. In the first group, 21 were immature and 20 were adults. In environment II, 30 were immature and 29 adult, making a total of 51 immature and 49 adult birds for study. Immature birds are believed to yield more accurate infection data for the Beaufort region than the adults because of the latter having been exposed to infection in several areas during migration.

Of the 100 hosts examined only two were free from worms, one immature bird from the "sandy" areas and one adult from the "muddy" areas. Of the infected birds, a total of nine species of trematodes, three species of cestodes, two species of Acanthocephala and seven species of nematodes were identified. When figuring percentages of infection, allowance was made for double infections within each of the four groups. Total infections for the four groups of parasites are: Trematoda, 42%; Cestoda, 51%; Acanthocephala, 83%; and Nematoda, 59%.

TREMATODA

Species found.—*Prosthogonimus ovatus* (Rudolphi, 1803) Lühe, 1899. *Leucochloridium beauforti* Hunter & Vernberg, 1952. *Gynaecotyla adunca* (Linton, 1905) Yamaguti, 1939. *Pseudospelotrema ammospizae* Hunter & Vernberg, 1953. *Microbilharzia lari* McLeod, 1937. *Microphallus nicolli* (Cable & Hunninen, 1940) Baer, 1943. *Conspicuum icteridorum* Byrd & Denton, 1951. *Levinseniella* sp., Stiles & Hassall, 1901. Immature echinostome.

Forty-two (43%) of the infected birds carried trematodes. Of these, 18 (44%) of all birds examined from environment I and 24 (41%) from envi-

ronment II carried members of this group. No environmental differences, therefore, were found. Immature birds, however, showed significant differences when compared with adults in both environments. Fifty-two per cent of the immature birds from environment I and 50% from environment II carried trematodes in contrast to the adults where 35% from environment I and 31% from environment II were infected. Specifically, *Prosthogonimus ovatus* should be cited, in which 13 of the 15 hosts were immature. It is also of interest that *P. ovatus* was recovered from 10 (18%) of the infected birds from the "muddy" environment (Type II) while only 5 (12%) from the "sandy" environment (Type I) carried this worm. This fact may be correlated with the relatively greater abundance of insect larvae in environment II and carries the assumption that *P. ovatus* has a life cycle similar to that of *P. macrorchis* Macy, 1934. Most specimens of *P. ovatus* were present in the bursal region of the immature hosts; however, in the two infected adults, they were found in the rectum. Table I summarizes the data for all trematodes.

CESTODA

TABLE I.—Summary of Data for all Trematode Infections

Species	Age of Hosts	No. of Birds Infected in Environments	
		I	II
<i>Conspicuum icteridorum</i>	Adult	—	1
	Immature	—	—
<i>Gynaecotyla adunca</i>	Adult	2	3
	Immature	2	4
<i>Leucochloridium beauforti</i>	Adult	1	—
	Immature	4	1
<i>Microbilharzia lari</i>	Adult	2	3
	Immature	—	—
<i>Microphallus nicolli</i>	Adult	—	—
	Immature	1	—
<i>Prosthogonimus ovatus</i>	Adult	1	1
	Immature	4	9
<i>Levinseniella</i> sp.	Adult	—	—
	Immature	1	—
<i>Pseudospelotrema ammospizae</i>	Adult	1	—
	Immature	1	2
Immature echinostome	Adult	—	2
	Immature	—	—
Unidentified	Adult	—	1
	Immature	1	1

Infected birds carrying trematodes = 43%

Infection in environment I = 44% (Adults—35%)

(Immatures—52%)

Infection in environment II = 41% (Adults—31%)

(Immatures—50%)

Species found.—*Choanotaenia infundibulum* Bloch, 1779. *Hymenolepis* sp., Weinland, 1858. *Ophryocotyle proteus* Friis, 1870.

Fifty-two per cent of the infected seaside sparrows carried cestodes. Eighteen (44%) from environment I and 33 (51%) of those from environ-

ment II were hosts for this group. Of the immatures, 10 (48%) from the "sandy" and 20 (67%) from the "muddy" environment were infected. Of the infected adults 8 (40%) were from environment I and 13 (45%) were from environment II. Environmental differences are more pronounced among the immature birds, and the greatest difference between the two age groups is also from the birds taken from environment II.

Choanotaenia infundibulum was more prevalent than any other species of cestode. Its distribution data (Table II) is the opposite of that for the total group. However, the lack of agreement may be explained by the migratory habits of the adult hosts. The distribution of this worm in immature birds does coincide with the overall data. Proportionately more of the cestodes had to be classed with the unidentified species than members of any other group because of the rapid disintegration of the strobilae in dead hosts. Table II summarizes the data for all cestodes.

TABLE II.—Summary of Data for all Cestode Infections

Species	Age of Hosts	No. of Birds Infected in Environments	
		I	II
<i>Choanotaenia infundibulum</i>	Adult	8	4
	Immature	9	15
<i>Hymenolepis</i> sp.	Adult	2	—
	Immature	1	1
<i>Ophryocotyle proteus</i>	Adult	—	2
	Immature	3	4
Unidentified	Adult	—	7
	Immature	—	4

Infected birds carrying cestodes = 52%

Infection in environment I = 44% (Adults—40%)
(Immatures—48%)

Infection in environment II = 51% (Adults—45%)
(Immatures—67%)

ACANTHOCEPHALA

Species found.—*Mediorhynchus papillosus* Van Cleave, 1916. *Plagiorhynchus formosus* Van Cleave, 1918.

Eighty-seven per cent of the infected birds harbored Acanthocephala. Thirty-six (87%) of those birds from environment I and 47 (80%) of those from environment II were infected. The data presented in Table III shows no significant differences in amount of infection between the hosts of the different areas, or between the two age groups. *Plagiorhynchus formosus* was much more prevalent from the birds taken in "muddy" areas, environment II, whereas *Mediorhynchus papillosus* was the predominant form from the "sandy" areas, environment I. Double infections with these two species were more numerous from the "muddy" environment II, 7 being in immature hosts and 2 in adult hosts. There were only 14 double infections in environment I and these were equally divided between the two age groups as hosts. Table III summarizes all data for the Acanthocephala.

TABLE III—Summary of Data for all Acanthocephala Infections

Species	Age of Hosts	No. of Birds Infected in Environments	
		I	II
<i>Mediorhynchus papillosus</i>	Adult	6	16
	Immature	10	22
<i>Plagiorhynchus formosus</i>	Adult	9	6
	Immature	9	8
Larvae	Adult	3	1
	Immature	—	1
Unidentified (Specimens lost in transit)	Adult	—	2
	Immature	2	—

Infected birds with Acanthocephala = 87%

Infection in environment I = 87% (Adults—85%)

(Immatures—91%)

Infection in environment II = 80% (Adults—79%)

(Immatures—85%)

NEMATODES

Species found.—*Capillaria* sp. (Zeder, 1800) Travassos, 1915. *Diplotriaena* sp. Raillet & Henry, 1909. *Dispharynx spiralis* (Molin, 1858) Skrjabin, 1916. *Microtetrameres cruzi* (Travassos, 1914) Travassos, 1915. *Oxyspirura petrowi* Skrjabin, 1929. *Species inquirendo*.

Sixty-two per cent of all infected birds carried nematodes. Environmental differences are better shown for this class of helminths than for any other group studied. Birds from environment II were consistently more heavily infected than those taken from environment I. Nematodes were found in 16 (39%) of the birds from environment I and in 43 (73%) of those from environment II. Of the immature hosts from environment I, 6 (29%) were infected compared to 19 (63%) from environment II. The adult infection was higher than that of the immatures for both environments. The adults may show effects of infection in outside areas, but the differences between environments is consistent with that of the immature hosts, where differences reflect purely local conditions.

A new and undescribed nematode was present in the intestine of 17 of the seashores. Two immature birds were infected in environment I while 7 immatures and 8 adults (total, 25%) were hosts for the species in environment II. Until the description of this form is complete, it will be referred to as *Species inquirendo*.

The eyeworm, *Oxyspirura petrowi*, was the most prevalent of all nematodes. Thirteen (32%) of birds infected from environment I and 28 (47%) of those from environment II carried this worm under the conjunctiva of the eyelids. Adult infections were only slightly higher than those found in the immature birds in environment I. In environment II, 16 (55%) of the adults and 12 (40%) of the immature birds in environment II were infected.

Microtetrameres cruzi, found in only three hosts, must be emphasized because of the apparent damage to its hosts' tissues. Twenty-one worms were taken from the wall of the proventriculus of one bird and 6 from the

second. These two birds were from environment II and also from the same local area. One adult from environment I provided two specimens. These bright red worms were tightly coiled in the tissues of the wall of the proventriculus and were the only parasites found which produced visible pathogenic effects.

Worms listed in Table IV as Spiruroids could not be identified to species because no male specimens were available and the two females were immature. The single *Capillaria* sp. was an incomplete specimen which prevented further classification. A single male and two immature females belonging to *Diplotriaena* sp. could not be completely classified.

TABLE IV.—Summary of Data for all Nematode Infections

Species	Age of Hosts	No. of Birds Infected in Environments	
		I	II
<i>Capillaria</i> sp.	Adult	1	—
	Immature	—	—
<i>Diplotriaena</i> sp.	Adult	3	—
	Immature	—	1
<i>Dispharynx spiralis</i>	Adult	1	—
	Immature	—	—
<i>Microtetrameres cruzi</i>	Adult	1	2
	Immature	—	—
<i>Oxyspirura petrowi</i>	Adult	7	16
	Immature	6	12
<i>Species inquirendo</i>	Adult	—	8
	Immature	2	7
Spiruroid	Adult	—	1
	Immature	—	1
Unidentified	Adult	1	2
	Immature	—	3

Infected birds carrying nematodes = 62%

Infection in environment I = 39% (Adults—50%)
(Immatures—29%)

Infection in environment II = 73% (Adults—83%)
(Immatures—63%)

SUMMARY

A survey of helminth parasites of Macgillivray's seaside sparrow, *Ammodramus maritimus macgillivrayi* (Audubon) from the vicinity of Beaufort, N. C. yielded new host records for nine species of trematodes, three of cestodes, two of Acanthocephala and seven of nematodes.

Comparisons of each group of worms from birds from two different ecological environments and from immature and adult hosts were made. Differences were not as great as expected between the rising shore, or driftline, and the flat, or non-driftline, types of environments. Immature birds carried a greater infection of all worms except the nematodes which were much more prevalent in the adults.

Infection in immature birds varied significantly in the two environments only in so far as cestodes and nematodes were concerned. It was impossible

to correlate differences in infections of adults because of their migratory habits.

Acanthocephalan infections were the most numerous. Nematodes, cestodes and trematodes, respectively, showed lower incidence in the total data.

REFERENCES

- BAER, JEAN G. 1943—Les Trematodes parasites de la Musaraigne d'eau *Neomys fodiens* (Schreb.). Bull. Soc. Neuchat. Sci. Nat. 68:33-84.
- CABLE, R. M. AND A. V. HUNNINEN 1940—Studies on the life history of *Spelotrema nicolli* (Trematoda: Microphallidae) with the description of a new Microphallid cercaria. Biol. Bull. 78:136-157.
- CRAM, ELOISE B. 1927—Bird parasites of the nematode suborders Strongylata, Ascaridata, and Spirurata. Bull. U. S. Nation. Mus. 140: 465 pp.
- 1937—A review of the genus *Oxyuris*, with a morphological study of *O. petrowi* Skrjabin, 1929, recently discovered in Galliform birds of the northern United States. Papers Helminth, 30 Yr. Jubileum K. I. Skrjabin:89-98.
- DAWES, BEN 1946—The Trematoda. Cambridge Univ. Press. 644 pp.
- DENTON, J. FRED AND E. E. BYRD 1951—The helminth parasites of birds, III. Dicrocoeliid trematodes from North American birds. Proc. U. S. Nation. Mus. 101(3274):157-202.
- HUNTER, WANDA S. 1952—Contributions to the morphology and life history of *Gynaecotyla adunca* (Linton, 1905) (Trematoda: Microphallidae). J. Parasit. 38:308-314.
- AND W. B. VERNBERG 1952—*Leucochloridium beauforti* (Trematoda: Brachylaemidae) from the Seaside Sparrow, *Ammospiza maritima macgillivraii* (Audubon). Ibid. 38:215-217.
- AND —1953—*Pseudospelotrema ammospizae*, sp. nov. (Trematoda: Microphallidae), from the Seaside Sparrow, *Ammospiza maritima macgillivraii* (Audubon). Ibid. 39:84-87.
- JOYEUX, C. AND J. G. BAER 1939 Sur quelques cestodes de Charadriiformes. Bull. Soc. Zool. France 64:171-187.
- LINTON, E. 1927—Notes on cestode parasites of birds. Proc. U. S. Nation. Mus. 70:1-73.
- MCLEOD, J. A. 1940—Studies on cercarial dermatitis and the Trematode family Schistosomatidae in Manitoba. Canad. Jour. Res. 18, Sec. D:1-28.
- SOUTHWELL, T. 1930—Fauna of British India. Cestoda, Vol. 2. London.
- VAN CLEAVE, H. J. 1918—The Acanthocephala of North American Birds. Trans. Am. Micr. Soc. 37:19-48.
- WARDLE, R. A. AND J. A. MCLEOD 1952—The Zoology of Tapeworms. U. Minn. Press. 780 pp.
- WITTENBERG, G. AND F. ECKMANN 1939—On the classification of the trematode genus *Prosthogonimus*. Vol. Jub. pro Prof. S. Yoshida, Osaka, 2, 129-144.
- YORKE, W. AND R. A. MAPLESTONE 1926—The Nematode Parasites of Vertebrates. London. 536 pp.

On Regenerative Capacity of Earthworms of the Family Lumbricidae

G. E. Gates

251 Silver Road, Bangor, Maine

Published records of regenerates at single transections, in one species, *Eisenia foetida* (Savigny) 1826, have been brought together in Tables, I, II of two recent articles (Gates, 1949, 1950). In this note, for the first time, there are brought together the records of single transection regeneration for other species of the same family. Also included are the records for *Criodrilus lacuum* Hoffmeister 1845 which has been, at various times, included in the Lumbricidae.

Anterior regeneration by posterior substrates.—Nearly all operations for which results have been published were in a region from 4/5 to 30/31 inclusive, as in the case of *E. foetida*. Regenerates at levels back to 15/16 inclusive or to 40/41 in case of *C. lacuum*, are included in the table herewith.

In a region from 16/17 to 30/31 inclusive, regeneration was not obtained by Hescheler from any of his 54 operated individuals of four species: *Allobophora caliginosa* (Savigny) 1826, *A. terrestris* (Savigny) 1826, *E. foetida*, *Lumbricus rubellus* Hoffmeister 1842 (see Hescheler, 1896, pp. 234-235).

For levels behind 30/31 there are records for four species. *A. terrestris*—Regenerates of unspecified nature, of 14 and "18-20" segments, at L19S and ca. L14S (12 unverletzten und 2 verletzten Segmenten," Korschelt, 1897, p. 102 and 1898, p. 80 and p. 82, fig. 7) respectively. As the species may have as many as 200 segments, the levels could be 181/182 and 186/187 or anteriorly. *L. rubellus*—Regenerate of unspecified nature, of eight segments,

NOTES TO TABLE I

- (i) That the pre-1900 regenerates listed here were actually cephalic is an assumption, but one with a very great probability of correctness.
 - (ii) With metameric abnormality, or segmentation uncertain or indefinite. Inhibited growths, "kleine Knospe" and "unsegm. Knospe," omitted.
 - (iii) The substrate, in this case, according to the explanation of fig. 2 of pl. 14, apparently was of 48 original segments with an older posterior regenerate of 51 segments.
 - (iv) Regenerates at 4/5 and 5/6 with little or no metameric differentiation omitted.
 - (v) One, or two, regenerates at intrasegmental levels omitted.
 - (vi) Cephalic regenerates of 5-6 segments at most, at levels 13/14 to 15/16, may have been secured in this species by Janda (1918, p. 520).
 - (vii) At levels from 16/17 to 25/26, juveniles regenerated heads usually of 16 segments in 9-13 days but adults regenerated much slower (Janda, 1926, p. 202).
 - (viii) Head regeneration at levels 35/36 to 50/51 seems to be indicated by Janda (1926, p. 80).
 - (ix) Maximum number of segments recorded in head regenerates, 25 (Janda, 1912, p. 560), but levels of regenerates of more than 17 segments apparently not specified.
- Species names in this contribution are those of the various authors but with changes necessary to conform to current nomenclatural practice. Any check of identifications of the various authors is of course now impossible. Hescheler's suggestion of misidentification brought prompt denial.

TABLE I.—Anterior regeneration in the Lumbricidae

Species	Level	Cephalic (i)							No (?) No (ii) regen- eration	Author	Date	Pages	Comments
		3	4	5	6	7							
<i>A. caliginosa</i>	5/6	-	1	2	-	-	-	-	-	Heschler	1896	227-233	Number of regenerates, 5.
	6/7 7/8	1	-	-	-	-	-	-	1	-	-	-	
<i>A. terrestris</i>	4/5	-	-	-	-	-	-	1	-	-	-	-	Number of regenerates, 45. (v)
	5/6	5	10	2	-	-	-	5	-	-	-	-	
	6/7	-	1	-	-	-	-	-	-	-	-	-	
	7/8	-	1	-	-	-	-	-	-	-	-	-	
	8/9	-	-	1	-	-	-	-	-	-	-	-	
	9/10	1	-	-	1	-	-	-	-	-	-	-	
	10/11	-	1	-	-	-	-	2	-	-	-	-	
	11/12	-	1	-	-	-	-	1	-	-	-	-	
	12/13	1	-	1	-	1 (iii)	-	-	-	-	-	-	
	13/14	-	1	-	-	-	-	1	-	-	-	-	
	14/15	-	-	-	-	-	-	1	-	-	-	-	
<i>L. castaneus</i> (Savigny) 1826	6/7	1	1	-	-	-	-	2	-	Gates	1949	567	Number of regenerates, (iv) 3.
	7/8	-	-	-	1	-	-	-	-	-	-	-	
<i>L. rubellus</i>	4/5	1	1	-	-	-	-	-	-	Heschler	1896	227-233	(v)
	5/6	1	1	-	-	-	-	2	-	-	-	-	
	7/8	2	1	-	-	-	-	-	-	-	-	-	
	14/15	1	-	-	-	-	-	-	-	-	-	-	
<i>L. terrestris</i>	5/6	3	-	-	-	-	-	-	-	-	-	-	Number of regenerates, 10. Number of regenerates, 4. (vi)
<i>C. lacuum</i>		10	11	12	13	14	15	16	17				(vii)
	10/11	7	-	-	-	-	-	-	-	Tirala	1912	527	
	11/12	-	-	-	-	-	-	-	-	Collin	1888	476	
	17/18	-	1	-	-	-	-	-	-	Janda	1912	347	
	20/21	-	-	-	2	-	2	1	-	Tirala	1912	528	
	25/26	-	-	1	-	1	1	-	-	Tirala	1912	528	
	40/41	-	-	-	-	-	-	-	+	Janda	1912	559	
	50/51	-	-	-	-	-	-	-	-	Tirala	1912	528	

Regeneration, presumably cephalic, recorded.
(viii) (ix). Number of regenerates, 19+.

at L48S (Korschelt, 1897, p. 93). As this species may have up to 120 segments, the level could be 72/73 or anteriorly. *Dendrobaena subrubicunda* (Eisen) 1874—Regenerate of unspecified nature and without segmentation at ca. L10S ("6 unverletzten und einem wenig verletzten Segment," Korschelt, 1897, p. 103). The species may have 110 segments, so the level could have been in the region of 100/101. This (and *idem*, p. 101) is the only reference that has been found to regeneration in any species of the genus *Dendrobaena*. *C. lacuum*—Heteromorphic tails obtained at unspecified levels, "äusserst selten" (Tirala, 1912, p. 529) may have been from fragments with two transections. Janda (1926, p. 429) noted that heteromorphic tails were never produced by juveniles, found them in adults "äusserst selten" (1930, p. 432), and also failed to indicate levels and whether the substrates involved were fragments with two transections.

Posterior regeneration by anterior substrates.—Few records of level of posterior regeneration have been found. *A. terrestris*—A regenerate of unspecified nature, with "10-12" indistinctly demarcated segments, at ca. 13/14 ("11 unverletzte und zwei angeschnittene Segmente," Korschelt, 1897, p. 100). *C. lacuum*—Tail regeneration, at 15/16, provided worms with nearly normal number of segments (Tirala, 1912, p. 539). Tail regeneration at 16/17, in juveniles, also provided complete animals of normal length (Janda, 1926, p. 430). One heteromorphic head, of 16 segments at 22/23 (1926, p. 450), as well as one each of 20 and 23 segments at unspecified levels, was obtained by Janda (1931, p. 150).

In *A. caliginosa* and *A. longa* Ude 1885 homomorphic tails have been regenerated in the laboratory (at levels?). Specimens of both species with natural tail regenerates (at levels?) have also been found. In species of *Eiseniella* regenerative capacity has been said to be high. No records of laboratory regeneration have been found. Presumably reference was to frequent occurrence of natural tail regenerates (at levels?) in collections.

A single record for *L. rubellus* is of a natural regenerate at an unspecified level (Hescheler, 1896, p. 243). However, Zielinska (1909, p. 469) was unable to obtain posterior regeneration in 29 specimens from which the last third had been amputated in June and October. There is one record for *Allolobophora chlorotica* (Savigny) 1826. It is of tail regeneration by an anterior "Hälfte," but only after nine months from time of autotomy (Hescheler, 1896, p. 242). This species may have 125 segments. The level of regeneration may have been at or in front of 62/63. In at least one species of *Octolasion* some regeneration apparently is possible.

L. terrestris L.—Regeneration buds of unspecified nature were formed by some anterior halves before his worms died according to Michel (1898, p. 264). More than that has not been recorded, numerous texts to the contrary, for experimental animals (Evans, 1946, p. 98; Hescheler, 1896, p. 243; Liebmann, 1942, p. 380, in ca. 100 specimens at various unmentioned levels; Zielinska 1909, p. 469, in 15 specimens after amputation of the last third). Nor have any records of natural regeneration been found. *Lumbricus* sp.—Regeneration, presumably posteriorly, "of lost segments does not seem to occur" in two unnamed species of the genus, in addition to *L. terrestris*

(Evans, 1946, p. 98).

Bimastos and *Eophila*—No records of regeneration, either experimental or natural, have been found for any species of these two genera.

Posterior regeneration in *A. terrestris* (at unspecified postclitellar levels) is obtainable only in the period of summer diapause beginning in April, but not at all in winter according to Abeloos and Avel (1928, pp. 737-738). Presumably reference was intended only to homomorphic regeneration.

Discussion.—Studies of regeneration in earth worms, from 1742 to 1898, apparently were motivated mainly by an interest in the process as a method of reproduction. Total numbers of segments in regenerates and substrates were compared with numbers in normal adults (Korschelt, 1897) and it was concluded that, "the exposed surface tends to regenerate all the structures that lie in front of or behind it in the normal worm" (Morgan, 1897, p. 582). Implicit in those studies was an assumption that regenerates produced at anterior transections were cephalic and that those produced at posterior transections were caudal. That such assumption might need verification seems not to have been recognized for some time, in spite of quite obvious similarities to tails shown in figures of various anterior regenerates.

With rediscovery of anterior heteromorphism, in earthworms (Michel, 1898; Morgan, 1899), interest in regeneration, rather surprisingly, seems to have waned. More than a quarter century passed before posterior heteromorphism was recognized, in *C. lacuum* (Janda, 1926) and in a non-lumbricid species (of *Perionyx*, Gates, 1927). Only very recently (Gates, 1949, 1950) have the data of earlier work been reexamined with reference to those two types of heteromorphism and then only in one species, *E. foetida*.

Meanwhile, results of some 1926-1927 experiments, only recently published (Gates, 1949, p. 135; 1950, p. 41), as well as others still unpublished, had indicated that a previous regeneration may have some effect on a subsequent regeneration. Although such effects may have been of little or no importance with reference to purpose of earlier investigators, definite presence of amputees and of previous regenerates in their experimental material should be born in mind in consideration of those results for other purposes (see, for instance, note iii in the table).

Furthermore, other and later experiments showed quite definitely (Gates, 1941, pp. 167-169) that in a species of *Perionyx*, regeneration at an anterior transection could drastically modify the morphological nature of a posterior regeneration simultaneously taking place on the same substrate. Such effects may not have been involved or significantly so, in earlier work on European species. Nevertheless, the debate in which Hescheler, Korschelt and his students Joest and Rievel, as well as Michel and Morgan were involved, and which led to a suggestion by Hescheler of misidentification of species, was confused by failure to discriminate between results of one-transection and simultaneous, two-level regeneration.

Results of differences in preoperational handling, anesthesia, method of operation, postoperational care, etc., are difficult to estimate. However, no two investigators seem to have used the same techniques. Hescheler appears to have made his cuts transversely and usually at intersegmental levels. Kors-

chelt's amputations, at least in some of his most interesting cases, were diagonal, crossing several segments. Effects of exposure by a diagonal cut of a surface greater than that in a transverse cut at an intersegmental level, is still to be determined. Some investigators kept operated animals in ingestible materials. Swallowing of any such material by anterior substrates can very seriously affect the outcome of certain experiments (Gates, in Ms).

The maximum number of segments was four in Hescheler's head regenerates (see note iii in the table). Six to eight segments (Carpenter, in Gates, 1949, p. 137, footnote), and even nine segments (Gates, 1949, p. 135) have recently been reported in *E. foetida*. This provides some support for opinions expressed long ago that conditions in Hescheler's experiments were less than optimal.

In the region behind 14/15 regeneration was obtained by Dimon and by Morgan, and even in both directions by the latter (in *E. foetida*). The negative results of Hescheler in the region of 15/16-30/31 were from experiments that averaged roughly to about one operation per level per species. Such negative results, obtained in less than optimal conditions, have been cited as evidence for existence in earthworms of a neutral region, i.e., a region of no regenerative capacity. Existence of such a neutral region has been assumed in some recent morphogenetic researches and apparently without critical examination of the concept and supporting data or adequate testing in the laboratory, in one case apparently even without adequate controls.

One hundred to 250 (450 in *C. lacuum*) clearly marked anteroposterior levels, according to species, are provided by the animals themselves in the forms that have been discussed. For one to fifteen only, of those numerous levels, again according to species, is direct information as to regeneration available. For just one single level, 13/14, in one species, *A. terrestris*, is there definite information as to regeneration in both directions, though the morphological nature of the posterior regenerate is unknown. Only one of the species herein considered, *C. lacuum*, is known to have both anterior and posterior heteromorphism, and even then the level of heteromorphic regeneration is known for just one individual. With one exception (*C. lacuum*), the data available are quite insufficient to permit recognition of existence even of major morphogenetic regions such as seems to exist in *E. foetida* (Gates, 1950, pp. 429 and 435).

Nevertheless such data as are available (summarized in Tables I, II of Gates 1949 and 1950, and on previous pages of the present contribution) seem to indicate interspecific variation in pattern of regenerative capacity. Thus, for instance, homomorphic tail regeneration may be possible as far forward as 13/14 in *A. terrestris*, forward only to 20/21 in *E. foetida*, but to 15/16 in *C. lacuum*. Again, heteromorphic tail regeneration may be possible as far back as L14S in *A. terrestris* or L10S in *D. subrubicunda* but apparently back only to 54/55 (L72S) in *E. foetida*. More fundamental differences apparently exist with reference to ability to regenerate posteriorly, ability to replace completely, lost portions including gonad segments, relationships of regenerative capacity to diapause, etc.

Summary—The literature has been searched for records of single-transsection regenerations which are presented in text and table. In the Lumbricidae, except in case of *E. foetida*, which had previously been considered, the information available is insufficient even to permit recognition of existence of major morphogenetic regions. In *C. lacuum* alone have both anterior and posterior heteromorphism been recognized. The evidence does seem to indicate specific variation in minor as well as major aspects of patterns of regenerative capacity. Results of one-level and simultaneous two-level regeneration must be clearly distinguished. In view of the influence of a second regeneration taking place simultaneously, regenerative capacity in earthworms must be first determined from regenerations at single transsections.

REFERENCES

- ABELOOS, M. AND M. AVEL 1928—Un cas de périodicité du pouvoir régénérateur. C. R. Soc. Biol. Paris 199:737-739.
- COLLIN, A. 1888—*Criodrilus lacuum* Hoffm. Zeit. wiss. Zool. 46:471-497.
- EVANS, A. C. 1946—Distribution of number of segments in earthworms. Nature 158:98.
- GATES, G. E. 1927—Regeneration in a tropical earthworm, *Perionyx excavatus* E. Perr. Biol. Bull. 53:351-364.
- 1941—Further notes on regeneration in a tropical earthworm. J. Exp. Zool. 88:161-185.
- 1949a—Regeneration in an earthworm, *Eisenia foetida* (Savigny) 1826. I. Biol. Bull. 96:129-139.
- 1949b—A six-segment head regenerate in a supposedly refractory earthworm species. Science 110:567.
- 1950—Regeneration in an earthworm, *Eisenia foetida* (Savigny) 1826. II. III. Biol. Bull. 98:36-45; 99:425-438.
- HESCHELER, K. 1896—Über Regenerationsvorgänge bei Lumbriciden. Jena. Zeit. Nat. 30:177-290.
- JANDA, V. 1912—Die Regeneration der Geschlechtsorgane bei *Criodrilus lacuum* Hoffm. I. II. Arch. Entwicklmech. Org. 33:345-348; 34:557-587.
- 1918—Neue Untersuchungen über die Regeneration der Geschlechtsorgane bei den Oligochaeten. Anat. Anz. 50:512-520.
- 1926—Die Veränderung des Geschlechtscharakters und die Neubildung des Geschlechtsapparats von *Criodrilus lacuum* Hoffm. Biol. Zentralbl. 46:200-204; Arch. Entwicklmech. Org. 107:423-455. Vest Cesk. Spol. Nauk (1925) Vejdovsky (5):1-88.
- 1931—Über die reparativen potenzien isolierter heteromorpher Schwänze bei *Rhynchelmis limosella* Hoffm. Arch. Entwicklmech. Org. 125:148-151.
- KORSCHULT, E. 1897—Über das Regenerationsvermögen der Regenwürmer. Sitzber. Ges. Naturwiss. Marburg 1897:72-105.
- Über Regenerations- und Transplantationsversuche an Lumbriciden. Verh. Deutsch. Zool. Ges. 1898:79-94.
- LIEBMANN, E. 1942—The correlation between sexual reproduction and regeneration in a series of Oligochaetes. J. Exp. Zool. 91:373-389.
- MICHEL, A. 1898—Recherches sur la régénération chez les annélides. Bull. sci. France Belg. 31:245-420.
- MORGAN, T. H. 1897—Regeneration in *Allolobophora foetida*. Arch. Entwicklmech. Org. 5:570-586.
- 1899—A confirmation of Spallanzani's discovery of an earthworm regenerating a tail in place of a head. Anat. Anz. 15:407-410.
- TIRALA, L. G. M. 1912—Regeneration and Transplantation bei *Criodrilus*. Arch. Entwicklmech. Org. 35:523-554.
- ZIELINSKA, J. 1909—Über Regenerationsvorgänge bei Lumbriciden. Jena. Zeit. Nat. 44:467-526.

Microdrili in Artificial Lakes in Northwest Arkansas

David Causey

University of Arkansas, Fayetteville

In recent years a number of artificial lakes have been formed in northwest Arkansas by damming mountain valleys. Formed over rather poor, thin soil and with steep, bare shore lines, they start out and tend to remain oligotrophic. Forbes' famous statement regarding the lake as a microcosm isolated and independent of the surrounding land would scarcely apply to these lakes which are so dependent upon their watersheds for nutrient materials. With the exception of Lake Weddington, what little aquatic and emergent vegetation occurs in them tends to be found at the upper ends where the feeding streams enter.

During the academic year 1950-51 a group of graduate students under the direction of Dr. Carl E. Hoffman made limnological studies of five such lakes in this area. The bottom samples were made available to me for a study of the microdrilian population. The limnological data presented in this paper have been largely supplied by Mr. Charles W. Nelson, a graduate student working under Dr. Hoffman's direction. I am indebted to Dr. Hoffman for the bottom samples and permission to use Mr. Nelson's tabulations of the data.

TABLE I.—General data for lakes

Lake	Impounded	Maximum Depth (in feet)	Surface in Acres	Use of Lake
Ft. Smith	1936	66	525.5	Water supply
Weddington	1937	39	81.5	Recreation
Atalanta	1937	37	77.0	Water supply
Fayetteville	1950	40	170.0	Water supply
Hindsville	1950	16		Recreation

Table I presents pertinent general data regarding the lakes studied. Lake Ft. Smith is the oldest and largest, with the largest water shed, and with limnological data available for over ten years. Lake Hindsville is the newest and at the time of the survey had not become filled to its ultimate capacity; limnologically it is scarcely more than a suddenly widened and deepened

TABLE II.—Physical characteristics of lakes

Lake	Temperature (°C.)		Surface Temperature (°C.)		Overturn (1950)	Strati- fication (1951)
	Highest	Lowest	Highest	Lowest		
Ft. Smith	28.1	5.0	13.2	5.0	Nov. 25	May 5
Weddington	27.9	4.2	16.4	4.0	Nov.	May 4
Atalanta	26.4	4.2	14.5	4.2	Nov. 7	Apr. 24
Fayetteville	28.7	3.1	17.2	3.1	Nov. 9	Apr. 9

stream. Lake Weddington and Lake Atalanta are of the same age, but differ in the use made of them, recreation and water supply, respectively. Lake Fayetteville differs from Lake Hindsville very slightly in age, but has filled to capacity and has rapidly taken on the limnological aspects of a lake. Some

physical characteristics of the lakes are presented in table II, and some physical and chemical data in table III.

TABLE III.—Physical and chemical data (averages)

Lake	Transparency (in cm.)	Nitrates (ppm)	Phosphates (ppm)	CO ₂ (ppm)	O ₂ (ppm)	pH	Bicar- bonates (ppm)
Ft. Smith	125.7	1.50	0.15	2.1	7.9	6.9	20.3
Weddington	246.0	0.86	0.07	2.4	8.3	7.5	55.0
Atalanta	135.8	1.23	0.17	2.3	8.8	7.9	102.5
Fayetteville	122.0	1.02	0.19	2.8	8.9	7.5	52.0

Methods.—The bottom samples available for investigation were distributed as follows: Lake Ft. Smith, 88 samples; Lake Atalanta, 73 samples, Lake Fayetteville, 56 samples; Lake Weddington, 51 samples; and Lake Hindsville, 28 samples. With one or two exceptions, these were taken between June 1950 and June 1951. Each was the bottom material obtained from one-fourth of a square foot of area taken with an Ekman dredge, screened through a 40 mesh screen, killed in 5% formalin, and preserved in 70% alcohol. In this study such samples were spread in the half of a Petri dish, examined under the broadfield microscope and representative worms taken, stained in borax carmine and mounted, a total of 696 worms being so prepared. With few exceptions, e.g., *Branchiura* and *Stylaria*, identification of unprepared specimens was found too uncertain to rely upon, and only *Branchiura* is here reported (in a few cases) without having been confirmed by a stained preparation. The microdrili are a notoriously troublesome group to work with, and this material as received was not ideal. Many specimens were incomplete,

TABLE IV.—Summary of bottom organisms in Ft. Smith. (averages of 1/2 sq. ft. samples)

Depth in Meters	Bottom	Volume (c.c.) of Organisms	Number of Organisms	Oligochaetes (%)	Chironomus Larvae (%)	Chaoborus Larvae (%)	Pelecypoda (%)	Gastropoda (%)	Others* (%)
0-5	Trash	52.6	7,104	69.0	17.0	6.0	4.0	2.0	2.0
5-10	Mud and Trash	38.3	5,090	70.0	14.0	3.0	11.0	P	2.0
10-15	Mud with Trash	45.8	16,999	89.0	6.0	5.0	0.0	0.0	0.0
15-20	Mud	61.4	16,022	97.0	1.0	2.0	0.0	0.0	0.0

* Hydras, nematodes, amphipods, etc. P—present.

and often the setal ends were broken away or eroded. In response to my criticisms regarding the condition of the material, Mr. Nelson brought me bottom samples as obtained, and I confess I was unable to improve upon the method.

Table IV presents the general picture of the bottom organisms for Lake Ft. Smith. In general the number of worms per bottom sample varied from none to several hundred and, as will be indicated, varied specifically accord-

ing to depth. A quantitative analysis of the samples, with actual identification of every specimen of each bottom sample for a year's run from a lake such as Ft. Smith would involve years of work and was not attempted.

TABLE V.—Distribution of Microdrili in lakes

Lake	Number of Samples	Number of samples in which genera indicated were present						
		<i>Dero</i>	<i>Nais</i>	<i>Pristina</i>	<i>Styleria</i>	<i>Branchiura</i>	<i>Limnodrilus</i>	<i>Tubifex</i>
Ft. Smith	88	0	5	2	0	22	61	16
Weddington	51	0	5	1	0	0	9	7
Atalanta	73	0	2	4	0	17	17	10
Fayetteville	56	6	23	6	2	0	20	3
Hindsville	28	3	11	0	7	0	2	0

SYSTEMIC AND BIOLOGICAL NAIDIDAE

Dero obtusa.—This species has appeared in only the youngest lakes, Fayetteville and Hindsville, and in four bottom samples from each lake. In Lake Hindsville it was confined to the first two meters with one exception, when it was found at 6 meters of depth. In Lake Fayetteville it was found at from 1 to 12 meters of depth. Combining the data for the two lakes, it was present in October and November of 1950, and in March, April, May and June of 1951. I regard it as a stream species which has washed in and which has maintained itself during this interval.

Of eighteen specimens mounted and examined, 5 showed fission zones and one was a portion broken away from a fission zone. Fission was present in specimens collected in April, May, and October. Depth is not a factor, as specimens from 1 to 11 meters showed fission zones. No trace of sex organs was found.

Nais elinguis.—This species has appeared in all the lakes examined, but irregularly in three of them. In Lake Ft. Smith it appeared in July of 1950 at a depth of 15 meters, and in August at 6 meters. In Lake Atalanta it also appeared twice, in July at 4 meters and in November (1950) at 3 meters. In Lake Weddington there were three appearances, late September, October, and at the end of November (1950), all at from 3 to 4 meters of depth. It was found to be commonly present in Lakes Fayetteville and Hindsville in every month of the year from June 1950 to June 1951, and at all depths from 1 meter to 7 meters.

A study of 103 specimens from the combined lakes disclosed 17 specimens with fission zones, and from all months except January, June, and August. It probably reproduces asexually the year round. Traces of sexual organs were found in 3 specimens from two lakes, Weddington and Fayetteville, and all were from June samples. Apparently there is no depth limitation to the reproductive activities, two specimens showing traces of sex organs coming from 1 meter of depth and one specimen from 11 meters, while specimens with fission zones were found in samples from 1 meter to 11 meters of depth.

Pristina aequiseti.—I assign certain of the specimens to this species with considerable hesitation. They are often fragmentary and badly preserved, appear abnormal, with setae much more delicate than usually found, and possibly represent a variety or a response to different conditions. Miss Sperber (1948) does not recognize any varieties.

The species is lacking in Lakes Hindsville and Weddington, and is sparsely present in the others. Apparently they are present the year round only in Lake Fayetteville, where they occurred in July and November of 1950, and January and May of 1951. In Lake Atalanta they occurred only in July, 1950, while in Lake Ft. Smith they were present in June, July, and October of 1950. They ranged in depth from 2 meters to 11½ meters, most being above the 10 meter depth.

Of twenty-two specimens mounted, only one from Lake Ft. Smith of the June 21,

1950 sample from 8 meters of depth showed traces of sex organs. None showed any indication of asexual fission.

Stylaria lacustris.—Like *Dero*, this species has appeared only in the two youngest lakes, Fayetteville and Hindsville. Only two bottom samples from Lake Fayetteville showed the species, and 7 samples from Lake Hindsville. None was found deeper than 5 meters and that in a single sample, the rest were all within the two meter level. They occurred in April and May of 1951 in Lake Fayetteville and from March to July in Lake Hindsville. Of a total of 43 specimens mounted, only one was not in some stage of fission, two had been broken away from fission zones, and the rest contained fission zones. No indication of sex organs was found. I regard this species as a stream form which has washed in, as with *Dero*, and probably less capable of maintaining itself under the lake conditions.

TUBIFICIDAE

Branchiura sowerbyi.—This gill-bearing form, first reported by Spencer (1932) for America, was the surprise of the investigation. It occurred only in Lakes Atalanta and Ft. Smith, and is common in the shallow areas of both lakes throughout the year. All but one record were within the first 7 meters of depth, and only six of 28 records were below 5 meters of depth. Some bottom samples were practically pure masses of the worms, ranging up to several hundred specimens per one-fourth square foot of area.

No trace of reproductive organs was found in any of the 52 specimens prepared from the two lakes. Since specimens were mounted primarily for identification purposes, and this one is readily recognized by its many gills, it is probable that there was an unconscious selection of the smaller ones, and that a more thorough investigation would show reproductive forms.

Limnodrilus clapedianus.—This common tubificid was present in all the lakes at some time. In Lakes Atalanta, Fayetteville, and Ft. Smith it was found throughout the year and at all bottom depths from 2 meters to 21 meters. It was, however, present in Lake Weddington just six times, in July, August, October, and November of 1950, and apparently has not reappeared. It occurred in Lake Hindsville only in the last two collections in June of 1951, within the first meter only, and I think that it had just arrived there when the collections came to an end.

Inspection of 382 mounted specimens revealed 25 with penial tubes, most of which were fully developed. In such a protandrous form the penial tube represents the halfway point in sexual reproduction. This indicates that some 13% of the worms were sexually mature. These sexual stages appear at all depths in the lakes and in every month of the year. More were found from the months of October, 1950 and May, 1951, but the number involved is too small to be significant. A few of the worms showed two tubes each, and one specimen had a tube protruded.

Tubifex tubifex.—This appears to be a common species in the well established lakes. It was not found in Lake Hindsville, was barely represented in Lake Fayetteville, but appears to be well established in Lakes Atalanta, Ft. Smith, and Weddington. In the two younger lakes it appears to be restricted to approximately the first 5 meters of depth, with few exceptions, whereas in the older Lake Ft. Smith it is found as far down as 13 meters of depth.

Out of 83 mounted specimens examined 53 showed recognizable sex organs in some stage of development. Combining all lakes, sexual specimens were present in each month of the year, and at all depths from 1 to 13 meters. Specimens from the same bottom sample tended to be in the same stage of development.

LUMBRICULIDAE

Lumbriculus inconstans.—A single specimen of this species appeared in a bottom sample from Lake Atalanta, April 24, 1951, from a depth of 10 meters.

Five specimens of Lumbriculidae, all from Lake Fayetteville, from June to August, 1951, and all from within the first 3 meters of depth. They are all immature and I am unable to assign them to a genus. They are not *L. inconstans*.

Megadrili.—A few immature specimens of *Diplocardia* sp. were found in a bottom sample from Lake Atalanta, May 8, 1951. They must have washed in from the nearby shore.

DISCUSSION

The microdrili show a type of stratification: in a general way the Naididae are on the more shallow bottom (0.5 meters) with a few specimens occasionally found deeper, while the Tubificidae are to be found from the shoreline to the deepest portions of these lakes. *Branchiura* is an exception, being confined mostly to the first 5 meters of bottom depth. Possibly this is to be correlated with the presence of gills in this form. Certain of the Naididae, e.g. *Dero* and *Stylaria*, appeared in the shallow portions of the two youngest lakes and were not found in the older lakes, and the *Nais*, while appearing in all the lakes, was irregularly present in the older lakes and continuously present only in the two youngest. This suggests that either they are being washed into the two young lakes and survive for some time, or more probably, that they can exist in the new lakes until the more stable lake conditions are achieved. *Pristina* is a marked exception to these statements for the Naididae, being absent in two lakes, one new and the other old, and irregular in its appearance in the others.

The Tubificidae appear to be more characteristic of the older lakes. *Branchiura* was not present in the two youngest lakes, was well established in Lakes Atalanta and Ft. Smith, but not present in Lake Weddington, an older lake. *Tubifex* was not found in the youngest lake, apparently only occasionally present in Lake Fayetteville, and well established in the older lakes. *Limnodrilus* was well established in all the older lakes except Lake Weddington, also well established in a new lake, Fayetteville, and apparently was just appearing in the youngest lake when the collections were discontinued.

The microdrili appear not to have been a major point of interest with limnologists in general (Eggleton, 1939). Moore (1939) gives a list of one of the Aeolosomatidae and 7 species of Naididae and the depths at which they were found. These suggest a stratification confined to the more shallow portions of Douglas Lake. The absence of Aeolosomatide in the Arkansas samples is probably due to the use of the Ekman dredge instead of the ooze sucker and the vertical core sampler used by Moore. They are common in our streams and ponds.

A rough quantitative relationship between the lakes is indicated in table V, derived from an analysis of the presence of the several species found at the various depths. The dominance of the oligochaetes in the bottom fauna is well indicated in table IV, where they make up from 69% to 97% of the organisms present in Lake Ft. Smith. According to Mr. Nelson, the total number of organisms in 84 bottom samples from Lake Ft. Smith in a year's investigation totaled 45,205, and of these 39,162 were oligochaetes. So far as present knowledge of this series of lakes is concerned, organic matter appearing may well end up in an oligochaete blind alley. Their intestinal contents show diatoms and rhizopoda. Their associates, the insect larvae and the molluscs appear not to utilize them, and Dr. Hoffman informs me that the oligochaetes are rarely found in fish stomachs from these lakes.

SUMMARY

The following microdrili were found in artificial lakes in N.W. Arkansas.—Naididae: *Dero obtusa*, *Nais elinguis*, *Pristina aequisetata*, and *Stylaria lacus-*

tris. Tubificidae: *Branchiura sowerbyi*, *Limnodrilus claparedianus*, and *Tubifex tubifex*. Lumbriculidae: *Lumbriculus inconstans* and a few of the family not assigned to any genus.

The distribution of the several species according to depth throughout the year is given, and the presence or absence of reproductivity is recorded.

Some limnological data for the lakes are given.

REFERENCES

- EGGLETON, F. E. 1939—Role of the Bottom Fauna in the Productivity of Lakes. Amer. Assoc. Adv. Sci. Publication No. 10, pp. 123-131.
- MOORE, G. M. 1939—A Limnological Investigation of the Microscopic Benthic Fauna of Douglas Lake, Michigan. Ecol. Mono. 9:537-582.
- SPENCER, W. P. 1932—A Gilled Oligochaete, *Branchiura sowerbyi*, new to America. Trans. Amer. Micr. Soc. 51:267-272.
- SPERBER, CHRISTINA 1948—A Taxonomical Study of the Naididae. Uppsala.

Morphology and Developmental Stages of *Piona linguaplax* n. sp. (Hydracarina:Pionidae) a Water-mite from North Carolina

Robert M. Crowell
College of Wooster, Wooster, Ohio

Collections of water-mites made in January, 1950, and during February, March and April, 1951, have yielded numerous specimens which appear to be new species of the genus *Piona* (*sensu strictu*). For this new species the name *Piona linguaplax* (L. *lingua* = tongue, Gr. *plax* = plate) is proposed, in reference to its most distinctive character, a pair of tongue-shaped genital plates extending laterally from the genital orifice.

The genus *Piona* Koch, 1842, contains numerous species and is of world wide distribution. Wolcott (1901) listed 19 species from North America. Several papers by Marshall have added 11 to the number of North American species.

Members of this genus can be recognized by the presence of prominent posterior projections from the fourth epimera, in combination with certain other characteristics. In males these projections are somewhat hidden under the genital plates. The palpi possess one or more (usually two) seta-bearing papillae on the flexor surface of segment four. Most outstanding characteristics of the genus are the remarkable modifications of legs III and IV in the male. Segment III-6 of the male is shortened, flattened, and somewhat truncate in shape, presumably adapted to serve as an intromittent organ for the transfer of sperm (Wolcott, 1901). Segment IV-4 of the male bears on its posterior side a deep excavation provided with blunt, spinelike processes by means of which the anterior legs of the female are grasped during mating.

All the specimens of this new *Piona* in the writer's collection were taken from a temporary pond in Plot 63, Durham Division, Duke Forest, Durham County, North Carolina. This pond was visited at irregular intervals of approximately two weeks each from 16 July, 1949 to 24 April, 1951. *Piona linguaplax* was collected only between 14-31 January, 1950, and 14 February-7 April, 1951. This form was taken by dipping, principally in and around clumps of pond vegetation. From cultures of pond debris observed in the laboratory over a period of several weeks, the pre-adult stages, including attached larvae, of *Piona linguaplax* have been recovered.

ACKNOWLEDGEMENTS

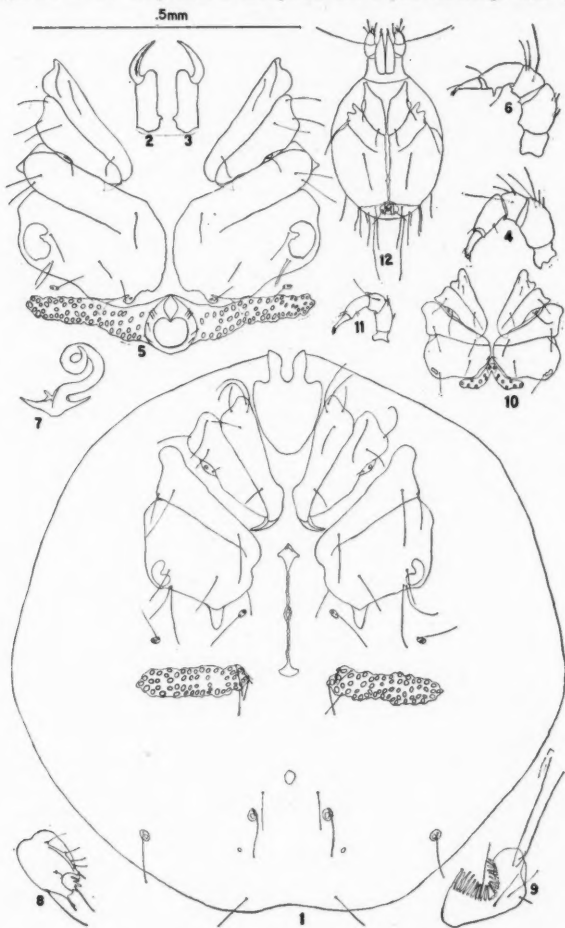
Thanks are extended to Dr. John R. Millar of the Chicago Natural History Museum who loaned specimens of *P. carnea*, *P. crassa* and *P. americana* from the Marshall collection for comparative study. Thanks are due also to Mr. Raymond Rigsbee of Duke University for technical assistance in preparation of illustrations.

Piona linguaplax n. sp.

Description.—The following description is based on materials selected from the above collections, plus immature stages reared in the laboratory. Entire and dissected specimens

have been mounted in Hoyer's mounting medium (Hoyer, 1882) and examined by phase-contrast microscopy.

Adult ♀ (Figs. 1-4): Adult females of the type series average 1.002 mm. (1.170 to 0.819 mm.) in length, by 0.929 mm. (1.080 to 0.780 mm.) in width after mounting. The integument of the living mites is transparent and a pale red-orange color (5.0 YR



Figs. 1-12. *Piona linguaplax*, n. sp.—1. Ventral surface; 2. Rt. chelicera, medial surface; 3. Rt. chelicera, lateral surface; 4. Rt. palpus, medial surface; 5. Ventral epimera and genital field; 6. Rt. palpus, medial surface; 7. Aedeagus; 8. Leg III, segment 6; 9. Leg IV, segment 4; 10. Nymph. Ventral epimera and provisional genitalia; 11. Nymph. Left palpus, lateral surface; 12. Larva. Ventral surface.

8/4 of Munsell, 1929). The legs of living specimens are generally a bright red-orange color (7.5 R 5/12 of Munsell, 1929). The pattern of markings visible in dorsal aspect appears to be due to the color of the viscera which shows through the integument. Two broad longitudinal black bands are apparent when viewed dorsally. In most specimens these seem to be joined anteriorly by a transverse band of about the same width. Between these bands there is frequently accumulated a mass of whitish material, the anterior end of which is slightly expanded laterally forming a short-pronged Y; this is probably of excretory origin.

The ventral epimera (Fig. 1) of the females are arranged in four groups of two each. The anterior pair of epimera bear prominent anchoral processes directed posteriorly reaching in some individuals beneath the third epimera. The second epimera lie posterolateral to the first epimera, from which they are separated by complete sutures. Concavities in the postero-lateral border of the second epimera contain large gland-pores, each with a seta situated medially from the pore. The posterior groups of epimera are separated from the anterior groups by a distance equal to approximately one-half the width of the second epimera. The third epimera are separated from the fourth epimera by a suture which is incomplete medially. The postero-lateral corner of each fourth epimera is arranged in the form of a rigid dorsal arch over the point of attachment of the fourth legs. The fourth epimera bear prominent posterior projections, which, together with the medial margins of the third and fourth epimera, partially enclose a V-shaped genital area. The distribution of setae on the ventral epimera is symmetrical and constant among individuals as shown in Fig. 1. Gland pores, each with an accompanying seta, are arranged in two pairs between the fourth epimera and the genital plates.

The external genitalia of the females consist of a slit-like genital orifice and a pair of genital plates. The genital orifice is in a median-ventral line. Its anterior end lies between the third epimera, its posterior end between the genital plates. The genital plates are distinctively tongue-shaped; those of the holotype each bears 53 acetabula. At the medial ends of the genital plates are five setae. This number seems to be constant among individuals, but their arrangement is somewhat variable.

The anal plate (Fig. 1) lies a variable distance behind the genital orifice and is flanked by two pairs of gland-pores accompanied by setae, two pairs of unspecialized setae, and a pair of small plates of undetermined function.

A broad, flat, shield-shaped plate with a pair of spatulate anterior projections lies ventral to the chelicerae. Hydrachnologists have called this the "maxillary plate." Since maxillae are considered wanting in the Acarina, it is proposed that this be termed the "gnathosomal plate."

Each chelicera (Figs. 2, 3) is two-segmented, consisting of a proximal cylindrical segment and a distal sickle-shaped segment. A row of serrations is apparent on the medial surface of the distal segment.

The basal segment (trochanter) of the pedipalpi (Fig. 4) is not enlarged as it is in many pionsas. The palpal femur (P-2) bears dorsally two pairs of setae, the distal pair of which is longer. The genu (P-3) bears dorsally one pair of setae. The proximal third of these setae possess overlapping scales. A long, fine seta arises from the lateral surface of this segment. The tibia (P-4) bears on its flexor surface a fine, short seta arising from a very slightly elevated papilla. Dorsally, at the distal end of this segment is another fine, short seta. The distal end of the terminal segment is formed into four or five minute papillae near which arise two very fine setae.

Adult ♂ (Figs. 5-9).—Males of *P. linguaplax* are smaller in size than females. The males are outnumbered by the females by approximately 14:1 in the writer's collection. Three complete males average 0.717 mm. in length (0.715 to 0.728 mm.) by 0.622 mm. in width (0.608 to 0.650 mm.). Color and markings are not significantly different from the females.

As in the females, the ventral epimera (Fig. 5) are arranged in four groups of two each. Anchoral processes from the posterior tips of the first epimera are well hidden under the tips of the second epimera and extend under the third epimera. The second epimera of the male are closely apposed to the third epimera, whereas in the female they are distinctly separated. Posterior processes from the fourth epimera are not as extensive in the male as in the female. Those of the male extend under the genital plates, which are much closer to the epimera in the male than in the female. The medial pair of two pairs of gland-pores situated between the genital plates and the epimera is on



Fig. 13.—Larva of *Piona linguaplax* attached to midge (*Tendipedidae*: *Polypedilum* sp.). One mite *in situ*, one displaced in mounting.

small plates joined to the fourth epimera. The pattern of setal distribution differs only slightly from the female. Only three setae are present on each first epimeron in the male as compared to five in the female. A pair of fine setae situated on the postero-medial angle of the fourth epimera of the female is wanting in the male.

External genitalia of the male consist of an ovate genital aperture flanked by, and fused with, a pair of tongue-shaped genital plates extending laterally. In the allotype male these genital plates bear 51 and 53 acetabula. The medial ends of the genital plates bear five setae variously arranged. Just within the genital orifice is an anchor-shaped aedeagus.

The highly modified leg segment IV-4 (Fig. 9) bears a number of stout, blunt spines in a deep excavation on its posterior surface. One unmodified seta is also present in this excavation, and a number of setae of varying lengths are present distal to the excavation. Segment III-6 is shorter than other terminal leg segments of the male, and considerably broader. It is flattened, slightly truncate and provided with relatively short, fine setae. It is by means of this modified segment that sperm masses are thought to be transferred from the genital orifice of the male to the genital orifice of the female (Wolcott, 1901; Marshall, 1929).

The palpi of males (Fig. 6) differ only slightly but distinctively from the palpi of females. Two pairs of setae on the palpal femur (P-2) are both short and of the same length, whereas in the female the distal pair is longer. Setae of the male palpal genu (P-3) are similar in number, distribution and kind to those of the female. The male palpal tibia (P-4) possesses setae similar to those of the female, and in addition a prominent, blunt papilla on its flexor surface. The palpal tarsus (P-5) of the male is similar to that of the female; its terminus, however, is more acute.

Nymph (Figs. 10, 11).—Three nymphs of *P. linguaplax* have been recovered from cultures of pond debris collected at the type locality on 14 January, 1950. Two of these averaged 0.341 mm. (0.306 to 0.377 mm.) in length by 0.289 mm. (0.254 to 0.325 mm.) in width. The color of living nymphs is somewhat paler than that of the adults.

The ventral epimera in the nymph, as in the adults, are arranged in four groups of two each. The suture which separates the first and second epimera is incomplete. A suture line between the third and fourth epimera is complete. The setae of the ventral epimera are fewer in number than those of adults, but it is possible to recognize by position certain setae which are retained in the adult, and others which are lost in the adults. A pair situated at the postero-medial angle of the fourth epimera in the nymph is retained in the adult female and lost in the adult male.

The provisional genitalia are in the form of two tongue-shaped plates joined medially and projecting into the inter-epimeral area. Two pairs of setae are present near the medial junction of the genital plates.

The palpi of the nymph are relatively longer than the palpi of either adult. Palpal setae are fewer in number in the nymph than in the adults. The long lateral seta on the palpal genu (P-3) of both sexes is recognizable in the same position in the nymph.

Larva (Fig. 12).—Numerous larvae have hatched in the laboratory from eggs laid by gravid females collected in the field. Those of the type series average 0.288 mm. (0.280 to 0.299 mm.) in length by 0.226 mm. (0.195 to 0.247 mm.) in width. The body of the larvae is almost completely sclerotized, there being soft integument only at the posterior end and the antero-lateral borders of the body, plus a narrow strip ventrally between the epimera. The anterior ventral epimera are separated from the second epimera by a complete suture. Sutures separating the second epimera from the third are incomplete medially. Differentiation of the third and fourth epimera has not occurred in the larva. The epimeral setae are few in number and seem to be constant in distribution among individuals. Numerous setae arising from the posterior end of the larva are constant in number but slightly variable in position among individuals.

From cultures of pond debris, midges of the family Tendipedidae (*Polypedilum* sp.) infested with larvae of *Piona linguaplax* have been recovered (Fig. 13). The temporal relationships of the mites and their host have not been determined. Experimental attempts to infest laboratory-reared mosquitoes (*Aedes aegypti* and *Culex* sp.) with larvae of this species have been unsuccessful.

Eggs (Fig. 14).—Eggs of *P. linguaplax* have been taken in the field and have been laid in rearing dishes in the laboratory by collected females. They may be laid singly or in masses up to 18 eggs. Generally they have been affixed to leaflets of

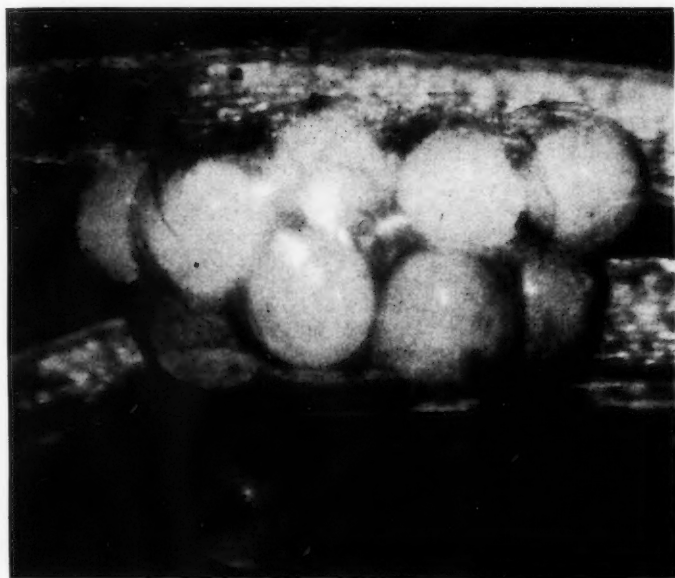


Fig. 14.—Egg mass of *Piona linguaplax* affixed to leaflets of sphagnum.

sphagnum or grasses or to the sides and bottom of the rearing dishes. Newly deposited eggs measure 0.17 mm. in diameter and are each surrounded by a gelatinous capsule measuring 0.272 to 0.306 mm. in diameter. These capsules adhere tightly to each other in masses of eggs. The color of newly deposited eggs is bright red-orange (7.5 R 5/12 of Munsell, 1929). Older eggs are paler in color and have larger gelatinous capsules.

The time required for first larvae to hatch from eight different masses of laboratory-hatched eggs varied from five to 13 days, with an average of 9.5 days.

DISCUSSION

Piona linguaplax is readily distinguishable from most other members of the genus in possessing genital plates of a characteristically elongate tongue-shape and of greater extent. *P. longipalpis* (Krendowsky, 1884) possesses genital plates of similar extent, which differ, however, in shape. Acetabula on the genital plates of *P. longipalpis* are numerous but differ from *P. linguaplax* in that two on each plate are much larger than others. Segment P-4 of females of *P. longipalpis* bears two long papillae, while none is present on P-4 of females of *P. linguaplax*.

P. linguaplax bears resemblance to *P. carnea* (Koch, 1836), *P. crassa* (Wolcott, 1901) and *P. americana* (Marshall, 1929) but can be differentiated from these forms. *P. linguaplax* differs significantly from specimens of *P. carnea* in the form and extent of the genital plates, and in the number of acetabula present on those plates, there being fewer in *P. carnea*. The palpi

of females of *P. carnea* bear more dorsal setae. P-4 bears two setae on its flexor surface as compared to one in *P. linguaplax*. The female genital plates of *P. crassa* are very similar to those of female *P. linguaplax*, but males of these two species differ in that respect. Both sexes differ in the form of the palpi, those of *P. crassa* being shorter and thicker than in *P. linguaplax*. *P. crassa* also differs in possessing a median dorsal plate not seen in *P. linguaplax*. The new species differs from specimens of *P. americana* in the shape of its genital plates and in the number of acetabula thereon, there being many more in *P. linguaplax*. Segment P-4 of *P. americana* bears three setae on its flexor surface as compared to one in *P. linguaplax*. A further significant difference is in the provisional genitalia of the nymphs of the two species. That of *P. linguaplax* resembles its adult form much more than that of *P. americana*.

DEPOSITION OF MATERIAL

Type material.—Types will be deposited as follows: Holotype female, allotype male and paratype female, male, nymph and larva in the Chicago Natural History Museum; paratypes of female, male, nymph and larva in the United States National Museum and in the writer's collection; paratype female, male, and larva in the Duke University acarology collections.

REFERENCES

- HOYER, H. 1882—Beitrage zur histologischen Technik. Biologisches Zentralblatt 2:23.
KOCH, C. L. 1836—Deutschlands Crustaceen, Myriapoden und Arachniden 8:12.
———1842—Übersicht des Arachnidensystems 3:13. Nuernberg.
KRENDOWSKY 1884—Travaux de la Societe de Naturalists a l'Universite Imperiale de Kharkow 18:291.
MARSHALL, RUTH 1929—The morphology and developmental stages of a new species of *Piona*. Trans. Wisc. Acad. Sci. Arts and Letters 24:401.
MUNSELL, A. E. O. 1929—Munsell book of color. 2 vols. Munsell Color Co., Inc., Baltimore, Md.
WOLCOTT, R. H. 1901—The North American species of *Curvipes*. Trans. Am. Micros. Soc. 23:201.

The Anatomy of the Feeding Apparatus of *Megisthanus floridanus* Banks, 1904, a Large Mesostigmatid Mite*

Flora Gorirossi and G. W. Wharton
University of Maryland, College Park

The anatomy of the gnathosoma or feeding apparatus of a few mites and ticks has been determined. However, the comparative anatomy of the gnathosoma of the mites has not yet been attempted in detail even within a single suborder. Currently, a comparative study of the anatomy of the gnathosoma of the Mesostigmata, one of the suborders of mites, is being undertaken. In order to obtain a satisfactory foundation on which such a study could be based, it was first necessary to become familiar with the structures found in several different types of mesostigmatids.

Previous detailed studies of the gnathosoma of the mesostigmatids have been primarily concerned with only one phyletic line, the Gamasides (Winkler 1886, Börner 1902, Stanley 1931, Hughes 1949, Gorirossi 1950). However, Oudemans (1928) reported in more than usual detail on the mouth parts of some of the Celaenopsina and Fedrizziina. Mites of six other phyletic lines of the Mesostigmata were therefore studied. Once familiarity with the modifications to be found within the mesostigmatid gnathosoma had been achieved, it became necessary to describe clearly one of the forms in such a way that the description would lend itself readily to comparison with other forms. Particular attention was given to the problem of naming the various elements that make up the gnathosoma so that only structures common to most of the mesostigmatids would receive names. The present description is the result of these studies. It is, however, restricted to an account of the gnathosoma of *M. floridanus*.

Snodgrass (1948), Hughes (1949), and Gorirossi (1950) summarized the literature concerned with the gnathosoma of mesostigmatid mites and related suborders of the Acarina. Hughes presents a table of terms employed by various authors in describing the mouth parts of the Arachnida. In the discussion that follows the description of the gnathosoma of *M. floridanus*, the terminology adopted here will be compared with the terminology of other authors.

METHODS AND PROCEDURE

Specimens of *Megisthanus floridanus* were found in the Duke Forest. Collections of the passalid beetle, on which this mite is found, were brought into the laboratory in large quantities. Each beetle was examined microscopically. The mites were then killed instantly with different fixatives. Studies were made from whole mounts, dissections and from histological sections.

Whole mounts.—Whole mounts of both males and females were made. The mites were first killed in boiling 70% or 80% alcohol. Some were mounted ventral side up and others dorsal side up. The mounting medium used was Hoyer's solution. The mites were cleared by heating the mount-

* This project was supported by ONR Contract N 7-ONR-45506 at Duke University, Durham, N. C.

ing medium after the preparation was made. Whole mounts are valuable for studying the relationship of the gnathosoma to the idiosoma of the mite.

Sectioning.—Mites to be sectioned were killed in hot Bouin's solution. They remained in Bouin's for at least 24 hours. After thoroughly washing the fixed specimens with 70% alcohol, they were placed in a mixture of 30% water, 50% ethyl alcohol, and 20% butyl alcohol; two changes of this mixture were made at half hour intervals. Dehydration was subsequently accomplished by immersing the specimens for a half hour in the following series: 15% water, 50% ethyl, 35% butyl; 5% water, 40% ethyl, 55% butyl; 25% ethyl, 75% butyl and finally absolute butyl alcohol. Specimens were then placed in fresh absolute butyl alcohol for an additional hour.

After complete dehydration the mites were transferred to a mush of $\frac{1}{2}$ absolute butyl alcohol and paraffin (51.6-52.8° C melting point) and placed in a paraffin oven over night. Butyl alcohol rises to the surface of the mixture and by decanting all but the fluid immediately surrounding the mite the greater portion of the alcohol was eliminated. Fresh paraffin was then added and the vial returned to the oven for one hour. The process was repeated until no odor of butyl alcohol could be detected. Three changes were usually required to eliminate all of the alcohol. The last paraffin change was used for embedding. The mite was oriented in the proper position for sectioning by using heated dissecting needles. The preparation was then placed in a cold water bath.

Horizontal, frontal and transverse serial sections, from 8-10 microns in thickness were made. The sections were stained with hematoxylin and counter stained with eosin. From such serial sections the arrangement and relationship of parts can be traced.

Dissection.—Mites for dissection were killed in 70% or 80% boiling alcohol and left in the alcohol for approximately a week. This procedure softened the exoskeleton. Needles were made by fitting fine *minuten Nadlens* securely into one end of an applicator stick. The ends of the needles were then ground to different shapes on a whetstone. A spatulate needle was used for lifting large structures such as the tectum from its attachment while a pointed needle was used for lifting and removing such small structures as the epipharynx. To dissect *M. floridanus* the gnathosoma was first removed from the idiosoma and the gnathosoma pinned to a wax-filled watch glass. The preparation was then covered with 80% alcohol. Using a high power dissection scope a systematic procedure of dissection was followed. First the dorsal surface of the gnathosoma was cut away and mounted in Hoyer's solution on a glass slide. As each successive structure was revealed by the dissection, it was mounted upon a slide or placed into a vial of 80% alcohol. The process of dissection was stopped at various levels and the preparation mounted for study. In most dissections of the gnathosoma, all the gnathosomal parts were dissected and mounted under a single cover slip. The gross anatomy of the parts as well as their relationships can be determined from such preparations.

RESULTS

Habits.—*Megisthanus floridanus* Banks (1904) is a large, heavily armoured, oval mite that is found associated with the common passalus beetle

Popilius disjunctus Illiger. *Passalus* lives in burrows in rotting oak logs in more or less a closed system. The ecology of the beetle has been studied by Pearse et al. (1936) and others. Despite these studies, little is really known of the economy of the numerous animals associated with the beetles, let alone those associated primarily with its burrows. Only the adults of *M. floridanus* are known. These have been found only on the beetles. They usually occur in pairs and are commonly seen on the ventral thoracic region of the beetles. They are not attached but move readily over the surface. The feeding habits of this large mite have not been observed. The structure of the mouth parts, however, suggests that it is either a predator or scavenger. Many smaller mites on the beetles are available as food for *M. floridanus*.

Gnathosoma.—*M. floridanus*, as well as most mites, can be divided into two body regions, an anterior small *gnathosoma* that bears the mouth parts, mouth, and associated structures, and a posterior *idiosoma* that bears the walking legs and contains the internal organs including those usually associated with the head, such as the brain. The two regions are movably joined by a synarthrodial membrane. The haemal cavities of the two regions are continuous, and certain of the muscles originate in the *idiosoma* and insert on the *gnathosoma* or *gnathosomal* structures such as the *chelicerae*.

If the *gnathosoma* is separated from the *idiosoma* and viewed from above (Pl. I A) certain features can be observed. Proximally, it will be seen to consist of a sclerotized ring from which certain structures protrude posteriorly. This outer sclerotized ring is the wall of the *gnathosomal base*. Laterally, the *gnathosomal base* is formed by the basal segment of the *pedipalps*. The dorsal and ventral components of the wall are probably derived from medial expansions of the *pedipalps*, at least in part. The *gnathosomal base* contains several structures such as the *chelicerae*, *subcheliceral plate* and *pharynx* which will be described later. Anteriorly, one median and two paired structures can be seen arising from the *gnathosomal base*. The lateral six-segmented *pedipalps*, shown in outline, are well developed. They are the second pair of appendages. Dorsal and medial to the *pedipalps* can be seen the paired *chelicerae*. The posterior ends of the *chelicerae* can also be seen at the posterior end of the *gnathosomal base*. Medially and dorsally the *gnathosomal base* projects anteriorly over the *chelicerae* to form the *tectum*. When the dorsal wall of the *gnathosomal base* and the *tectum* are removed (Pl. I B) the entire *chelicerae* are revealed. The *chelicerae* are surrounded by *internal cheliceral sheaths* in which they glide. Enclosed within the *internal cheliceral sheaths* and directly investing the *chelicerae* are the *external cheliceral sheaths*. Removal of the *chelicerae* with their sheaths reveals (Pl. I C) the *subcheliceral plate*, the posterior margin of which extends beyond the posterior margin of the external wall of the *gnathosomal base*. The *subcheliceral plate* is continuous with other *gnathosomal* elements. In the center of the *subcheliceral plate* there is a hexagonal opening through which a fan-shaped group of muscles is visible. The anterior margins of the *subcheliceral plate* are joined by a bridge over the mouth. This bridge is called the *epistome* because it serves the same function as the *epistome* of insects, namely: origin of some of the pharyngeal dilator muscles and at its anterior end it supports the upper lip or *labrum*. The *labrum* appears as an irregularly branched, attenuate projection.

Ventral to the labrum the spiny *epipharynx* can be seen. The fan-shaped group of muscles that originates on the posterior margin of the subchelicerar plate inserts in the epipharynx. The epipharynx is rectangular in cross section and fits into a groove anterior to the mouth. Lateral to the epistome and subchelicerar plate a *tentorium* extends to the palps. The tentorium is fused with the epistome and the subchelicerar plate and is continuous with the medial wall of the coxal segment of the pedipalps. Anteriorly, the tentorium is fused with the dorsal wall of the *hypostome*. At the anterior lateral corners of the dorsal hypostomal wall a pair of projections, *corniculi*, arises that guide the chelicerae. The corniculi articulate with the dorsal hypostomal wall by means of a movable joint. A pair of anterior projections of the hypostome, *hypostomal processes*, can be seen extending beyond its apex. Removal of the epistome, labrum, epipharynx, and epipharyngeal muscles (Pl. I D) reveals the pharynx, a tube in the mid line. The pharyngeal dilator muscles can be seen extending laterally from the pharynx, while the dorsal constrictors are seen alternating with the dilators. The constrictors are attached to the pharynx at each side. The opening of the pharynx is the *mouth*. The dorsal wall of the pharynx is continuous with the epipharynx which extends anterior to the mouth. The ventro-lateral walls of the pharynx extend anteriorly to form the *hypopharynx*. The hypopharynx forms a groove or trough in which the epipharynx lies. On either side of the base of the hypopharynx is an *hypopharyngeal stylus*. The toothed walls of the hypopharyngeal groove are typical of this region of the gnathosoma (Pl. I E). Anteriorly, the paired *hypopharyngeal processes* which are extensions of the hypopharynx can be seen. Ventral to these structures and medial to them the hypostomal processes are partially visible. On the ventral surface of the gnathosoma (Pl. I F) the single pair of *gnathosomal setae* can be seen on the gnathosomal base. Anterior to these setae is the hypostomal region that characteristically bears three pairs of *hypostomal setae*.

In the mid-ventral region a longitudinal groove divides the gnathosoma into right and left halves. This groove is divided into anterior and posterior regions. The posterior portion is restricted to the gnathosomal base and is formed by the *deutosternum*. The anterior portion is in the region of the hypostome and is formed by the *protosternum*. Its floor is formed from the hypopharynx.

The description of the gnathosoma presented above and the diagrams that illustrate it are based on a simplified account of the structures. While the description and diagrams are simplified they are accurate in proportion and in showing the relationships of the main sclerotized structures. Fundamentally, the gnathosoma consists of a basal portion, five anterior projections and two pairs of appendages. The basal portion is similar to a cylinder that is divided into dorsal and ventral compartments by a horizontal shelf. The dorsal section is subdivided into right and left halves by the chelicerar sheaths in which the chelicerae glide, while the ventral section accommodates the pharynx and the pharyngeal musculature. The anterior projections arise at different levels from the gnathosomal base. The tectum originates from the dorsal wall of the base, the labrum from the center of the horizontal shelf that divides the base into dorsal and ventral compartments, the epipharynx from

the dorsal wall of the pharynx, the hypopharynx from the ventrolateral walls of the pharynx, and the hypostome from the ventral wall of the base ventrally and dorsally from the lateral portions of the horizontal shelf that divides the

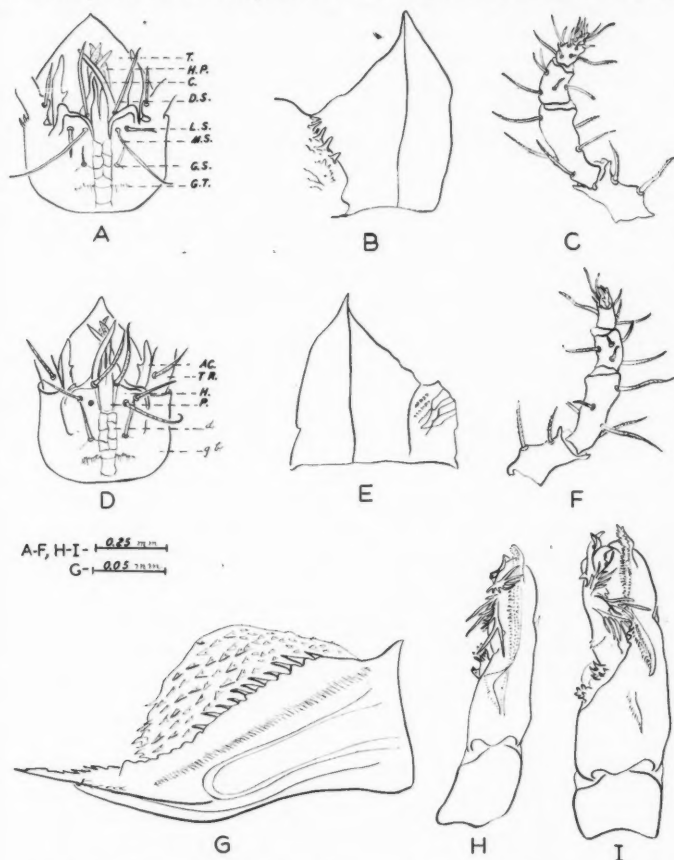


Fig. 1.—Gnathosoma of *Megisthanus floridanus*. A. Ventral view of the gnathosoma of a male; B. Lateral view of the gnathosoma of a male to show teeth flanking tectum; C. Palp of a male, lateral view; D. Ventral view of the gnathosoma of a female; E. Lateral view of the gnathosoma of a female to show teeth flanking tectum; F. Palp of a male, medial view; G. Epipharynx; H. Medial view of the chelicera of a male; I. Medial view of the chelicera of a female.

ABBREVIATIONS: ac.—corniculi, c. hypostomal processes, d.—deutosternum, d.s.—distal setae of hypostome, g.b.—gnathosomal base, g.s.—gnathosomal setae, g.t.—gnathosomal teeth, h.—hypostome, h.p.—hypopharyngeal processes, l.s.—lateral setae of hypostome, m.s.—medial setae of hypostome, p.—protosternum, t.—tectum, tr.—trochanter.

gnathosomal base dorso-ventrally. The chelicerae articulate with the anterior margin of the dorsal compartment of the gnathosomal base through the external cheliceral sheaths. The coxae of the pedipalps are insensibly incorporated into the gnathosomal base and make up a considerable portion of it. They are discernible laterally and extend beyond the base where they are fused with the lateral margins of the hypostome. The trochanters articulate movably with the anterior limits of the coxae. The other segments of the palps are also movably joined to their neighbors.

Gnathosomal base.—(Fig. 1 A, D) The gnathosomal base is that portion of the gnathosoma that is posterior to the mouth. Its external surface is largely smooth but some ornamentation is present. In the mid-ventral line the deutosternum is found. On either side of the deutosternum half way between its proximal limit and the base of the gnathosomal setae is a transverse row of small teeth. The teeth are directed anteriorly, and their number vary from one side of the gnathosomal base to the other. The sides of the gnathosomal base are ornamented with a series of diagonal rows of teeth and ridges, and its dorsal surface is marked by a series of fine transverse ridges. The palpal coxae are partially set off from the central portion of the gnathosomal base by dorsal and ventral lateral grooves.

Deutosternum.—(Fig. 1 A, D) The floor of the mid-ventral groove on the surface of the gnathosomal base is the deutosternum. It lacks the teeth characteristics of the other species but is provided with a series of six transverse ridges.

Gnathosomal setae.—(Fig. 1 A, D) A single pair of setae located near the anterior end of the gnathosomal base is characteristic of all the Mesostigmata. In *M. floridanus* these setae are shorter than the hypostomal setae and are shorter in the male than in the female.

Subcheliceral plate.—(Pl. I) The transverse shelf that divides the gnathosomal base into dorsal and ventral components is formed in part by the U-shaped subcheliceral plate. The plate is an apodeme and extends into the idiosoma. The bars of the plate provide the surface upon which the chelicerae glide, while the internal sheaths of the chelicerae originate from the mesial and lateral side of the bars. The epipharyngeal depressor muscles originate from the posterior portion of the plate.

Epistome.—(Pl. I C, G) The epistome is that portion of the plate from which the dilator muscles of the pharynx originate and the labrum projects. Here the epistome forms an anterior bridge connecting the bars of the subcheliceral plate. A distinct keel is present on the dorsal surface of the epistome.

Internal cheliceral sheaths.—(Pl. I B, G) At the anterior region of the gnathosomal base the chelicerae are surrounded by a complete sclerotized ring formed above by the junction of the tectum with the gnathosomal base, formed laterally by the mesial walls of the pedipalpal coxae and ventrally by the epistome. This ring is divided into right and left halves by a vertical plate that arises from the keel of the epistome and extends to the base of the keel of the tectum. Thus, each chelicerae is surrounded by an external sclerotized ring. Apodemes extend posteriorly from these rings to the posterior end

of the subcheliceral plate providing two tubes in which the chelicerae glide. These are the internal cheliceral sheaths.

External cheliceral sheaths.—(Pl. I B, G) A membranous tube, that directly invests each cheliceral shaft for more or less its length depending upon its degree of retraction, inserts on the shaft just distal to the junction of the first and second segments. This tube is the external cheliceral sheath and joins the gnathosomal base at the point of origin of the internal cheliceral sheaths. It is, in fact, a greatly elongated synarthrodial membrane. Its length and flexibility make it possible for the cheliceral to be protracted and retracted. Each chelicerae is provided with its own sheath so that it can operate independently of the other.

Tentorium.—(Pl. I C, D, G) The tentorium is that part of the horizontal shelf dividing the gnathosomal base into dorsal and ventral compartments that connects the subcheliceral plate and epistome with the mesial walls of the pedipalpal coxae. Anteriorly, the tentorium is heavily sclerotized but posteriorly it is membranous. The entire tentorium is an apodeme.

Pharynx.—(Pl. I D, E, G) The pharynx is a tube connecting the mouth with the esophagus. It is rectangular in outline and has a sclerotized lining. Two types of dilator muscles insert on the pharynx. The anterior dilators insert on the dorsal lateral corners of the tube and originate from the epistome. Posteriorly, there are a series of dilators that insert on the lateral walls of the pharynx and originate laterally from the ventral lateral walls of the gnathosomal base. The constrictors of the pharynx are intrinsic and alternate with the dilators in their attachment to the pharyngeal wall. The constrictors run from corner to corner. Three sets are present. A dorsal set connects the two dorsal corners, two lateral sets connect the dorsal and ventral corners of the right and left sides respectively, but the ventral corners are not connected by pharyngeal constrictors.

Mouth.—(Pl. I D, E) The mouth is the anterior opening of the pharynx. It is shaped like an inverted pyramid and is closed by the apposition of the epipharynx with the walls of the hypopharyngeal groove. The description of the mouth completes the description of the gnathosomal base and its parts.

Tectum.—(Pl. I A; Fig. 1 A, B, D, E) Dorsally the tectum is attached at its broad, arched, posterior margin to the dorsal wall of the gnathosomal base. It is insensibly fused with the base but can readily be differentiated from it by its ornamentation. Transverse ridges are characteristic of the gnathosomal base, while longitudinal ridges are found on the tectum. The tectum is shaped like an equilateral triangle. Its apex is anterior. Ventrally, the tectum is provided with a distinct keel. The tectum of the male is larger than that of the female and possesses large teeth on either side, which are much reduced in the female.

Labrum.—(Pl. I B, C) The external extension of the epistome is the labrum. It is an attenuate branched structure with one long and as many as seven smaller branches. All of the branches come off near the base of the labrum.

Epipharynx.—(Pl. I C, H; Fig. 1 G) The dorsal pharyngeal wall is extended anteriorly beyond the mouth as an epipharynx. The epipharynx in cross section appears as a four-sided structure. It resembles a spear in which

the dorso-lateral sides do not extend as far as the ventro-lateral sides. The ventro-lateral walls are more heavily sclerotized, with two series of teeth on their surfaces. The dorso-lateral walls form a dome which is densely covered by small barb-like projections. The epipharynx lies in the hypopharyngeal groove. The depressor muscles, originating from the posterior ventral surface of the subchelicerar plate, insert on the inner surface of the epipharynx and are concentrated mainly at the base. Upon contraction of these the epipharynx is lowered into the hypopharyngeal groove and blocks the pharyngeal orifice or mouth. The epipharynx and labrum fuse proximally at the level of the mouth.

Hypopharynx.—(Pl. I D, E, H) The ventro-lateral pharyngeal walls extend beyond the mouth as a hypopharynx. The hypopharyngeal walls form a V-shaped groove in which the epipharynx lies. These walls are provided with a series of small teeth. Laterally, the teeth are larger and more apparent. The hypopharyngeal dilator muscles insert on the internal surface of the walls and originate from the ventro-lateral walls of the hypostome.

Hypopharyngeal processes.—(Pl. I D, E, F; Fig. 1 A, D) The hypopharynx splits into right and left halves anteriorly and continues to form a pair of hypopharyngeal processes. Each process ends in a small knob that is provided with denticles over its surface. The protosternum also contributes to the formation of the hypopharyngeal processes.

Hypopharyngeal styli.—(Pl. I D, E) A pair of styli arise from the corners of the mouth at the dorsal level of the hypopharynx where the epistome, hypostome, epipharynx and hypopharynx come together. The styli are thin rods that extend to the level of the anterior limit of the hypopharyngeal groove. They are provided with minute denticles that can be seen only with the aid of a phase contrast microscope. The function of the hypopharyngeal styli has not been determined. On other mesostigmatid mites additional pairs of styli have been found.

Hypostome.—(Pl. I C, F, H; Fig. 1 A, D) The ventral wall of the gnathosomal base continues anteriorly to form the ventral wall of the hypostome. The dorsal wall of the hypostome extends anteriorly from the tentorium and fuses distally with the ventral wall of the hypostome. The hypostome is almost completely separated into right and left halves dorsally by the median hypopharynx. The separation is almost complete on the ventral surface as well but is incomplete at its proximal limit. Laterally, the hypostomal walls are fused to the walls of the pedipalpal coxae. The hypostome is devoid of ornamentation.

Hypostomal setae.—(Pl. I F; Fig. 1 A, D) On the ventral wall of the hypostome are located three pairs of hypostomal setae. The anterior setae or distal setae are intermediate in length and are provided with setules. The two pairs of posterior setae can be designated medial and lateral. The lateral setae are the shortest and are provided with setules while the medial setae are the longest and are nude.

Protosternum.—(Pl. I F, H; Fig. 1 A, D) The protosternum abuts the deutosternum and extends into the hypostomal region. The floor of the hypostomal groove is formed by the protosternum and can be readily distinguished from the deutosternum.

Hypostomal processes.—(Pl. I C, D, E, F; Fig. 1 A, D) From the divided anterior apices of the hypostome extend a pair of slender hypostomal processes. They taper to a fine point and entwine about the hypopharyngeal processes distally.

Corniculi.—(Pl. I C, D, F; Fig. 1 A, D) The corniculi are large, darkly colored, heavily sclerotized structures which project from the dorsal wall of the hypostome. They resemble horns and have a single median projection on their mesial surface. They are lateral to the chelicerae when these are extended and prevent extensive lateral movement of them.

Chelicerae.—(Pl. I A, B, G; Fig. 1 H, I) The first pair of acarine appendages is the chelicerae. They are three-segmented, powerful structures, approximately four times longer than they are broad. The proximal segment is the shortest of the segments and is the only one which lacks any accessory structures; it is internal and therefore might be considered a chelical apodeme. The second segment is the longest of the three and terminates in an immovable digit provided with thirteen teeth. At the level of the second tooth of the immovable digit is a seta which projects distally from the dorsal surface. The third segment of the chelicera opposes the immovable digit and in the living mite occupies the ventral position. It forms the movable digit. Sometimes on the ventral margin a series of posteriorly directed teeth are visible but these do not appear to be a constant feature because on the same mite they are not always present on both chelicerae. The number of teeth on the movable digit ranges from seven to nine. Both the second and third segments of the chelicerae possess elaborate excrescences on their mesial surfaces. Originating from the immovable digit opposite the ninth tooth is a delicately sclerotized structure which extends from a region posterior to the base of the digit and projects beyond its distal tip. Covering the greater portion of this excrescence are teeth arranged in several longitudinal series. There are three types of excrescences on the movable digit. The most distal is excavated anteriorly and bears serrations on its edge. Posterior to this are two multi-branched outgrowths. The proximal one covers the greater surface of the digit. The synarthrodial membrane between the second and third segment is thrown into a disc-shaped fold with teeth on its rim. At the base of this is an additional group of teeth. The description given above applies to the chelicerae of the female. In the male the chelicerae are similar to those of the female. They differ primarily in that the excrescences are more numerous and more prominently developed. The movable digit of each chelicera is operated by a pair of opposed muscles. The elevators of the digit originate along the proximal and mesial walls of the second segment. They insert on the sides of a vertical apodeme, arranged much as the barbs of a feather along the rachis, which is directly posterior to the dorsal proximal angle of the movable digit. The elevator muscles are connected to the digit by means of a tendon. The depressor muscles of the movable digit are six times smaller in diameter than the elevators. They insert on the proximal ventral surface of the digit by means of a tendon and are concentrated along the ventral surface of the second segment, originating proximally on that segment. Other intrinsic muscles which originate from all surfaces of the first segment insert along

the proximal edge of the second segment and along the apodeme. The extrinsic muscles of the chelicerae are retractor muscles, the contraction of which pull the chelicerae into the idiosoma. The muscles insert along the base of the first segment and originate from a restricted area located at the level of the anterior third of the dorsal wall of the idiosoma. The chelicerae are protracted by the pressure of the body fluids.

Pedipalps.—(Fig. 1 C, F) The second pair of acarine appendages is the pedipalps. They are composed of six segments: the coxa which forms the greater portion of the lateral sides of the gnathosomal base; the trochanter which is the first movable segment; the femur which is the longest of the segments; the genu, the tibia and the tarsus. Designating the trochanter as number 2, the movable segments of the pedipalps vary in size in the following order—3, 2, 4, 5, 6. The trochanter has two setae which project medially, each possesses setules. The mesial apex of the segment bears two or three knob-like projections. The femur has five setae each with setules. From the medial surface the shortest seta occupies approximately a central position. The remaining four setae are of approximately the same length. Three originate laterally and one arises posterior to the shortest seta on the ventral surface of the segment. The genu has seven setae all with setules. A medial one differs from the others by being unusually well provided with setules at its tips and instead of being straight curves anteriorly at its tip. Of the remaining six: three are on the dorsal surface, two on the lateral, and one on the ventral. The longest seta is the more posterior of the lateral ones. The tibia appears to have fifteen setae. The exact number is difficult to establish because of the proximity of the setae to each other. Except for two setae which project medially the setae of the tibia possess few or no setules. In addition to the two on the mesial surface, there are approximately four on the ventral surface, two on the dorsal surface and the remaining are concentrated along the distal lateral surfaces. The most conspicuous of the tibial setae is the posterior one of the two medial setae. It is as long as the longest setae of the pedipalps or longer. It, as well as the posterior medial setae of the genu, projects anteriorly but with a less acute angle and its setules are not concentrated at the tip but extend equally along its length. The more anterior of the two medial setae has the smallest diameter of any of the pedipalpal setae and can be grouped among the shortest. It has, however, relatively long setules along its edges. The tarsus differs sharply from the other segments because of the arrangement of the setae. Nine setae arranged in a corona at the apex of the segment occupy about one-half the lateral surface. The setae are more robust than the others and are all of about the same size except for the most distal one which is more slender and longer than the others of the corona. Two setae medially and one, the narrowest of the tarsal setae, is on the ventral surface. Of the two medial setae, the most posterior is the longer and recurves slightly distally and then ventrally. Both are provided with few setules as is also the ventral seta but setules are lacking from the other setae. A three tined specialized seta arises from the mid-dorsal surface of the tarsus at its proximal margin. The medial tine is approximately six times shorter than either the central or the lateral tine.

TABLE 1.—Synonymy of terms

	Gorirossi (1950)	Hughes (1949)	Snodgrass (1948)
Gnathosoma	Gnathosoma	Gnathosoma	Capitulum
Gnathosomal base	Basis capituli	Basis capituli	Basis capituli
Deutosternum	Capitular groove	Deutosternum, Hypostome	—
Gnathosomal setae	Capitular setae	Capitular hairs, Post. rostral hairs, Post. max. hairs	—
Subcheliceral plate	Epistome (part)	Subcheliceral plate (part)	Subcheliceral epistomal plate Epistome
Epistome	Epistome (part)	Subcheliceral plate (part)	Epistome
Int. cheliceral sheaths	Outer cheliceral sheaths	Cheliceral sheaths	—
Ext. cheliceral sheaths	Inner cheliceral sheaths	Cone-sheaths	Inner cheliceral sheaths, Outer chel. sheaths
Tentorium	Ventral extension of epistome	—	—
Pharynx	Pharynx	Pharynx	Pharynx
Mouth	Mouth	Mouth	Mouth
Tectum	Tectum, tectum capituli	Epistome	Tectum, tectum capituli
Labrum	Labrum	Labrum	Labrum (part)
Epipharynx	Epipharynx	Epipharynx, Paralabrum internum, paralabrum externum	Labrum (part)
Hypopharynx	Ant. v.l. walls of pharynx (part)	Ant. v.l. walls of pharynx (part)	Hypostome (part)
Hypopharyngeal processes	—	Mala interna	Hypostomal processes
Hypopharyngeal styli	Styli ?	Salivary styli ?	Stylus ?
Hypostomal setae	Hypostomal setae	Rostral setae	—
Hypostome	Hypostome (part)	Hypostome (part)	Hypostome (part)
Protosternum	Floor of hypostome	Ant. prolongations of hypostome, ven. flap of endite	Hypostome
Hypostomal processes	Stylus of mala externa	Endites of pedipalpal limbs, Flange of mala externa	Hypostomal processes
Corniculi	—	—	Apical lobes of coxae
Chelicerae	Chelicerae	Chelicerae	Chelicerae
Pedipalps	Pedipalps, palps	Pedipalps	Pedipalps

DISCUSSION

In describing the gnathosoma of *Megisthanus floridanus* particular attention has been given to the terminology since it is hoped that this description can be used as a basis for a study of the comparative anatomy of the mesostigmatid gnathosoma. The terms applied to the structures in this paper have been compared to those used by other authors, especially three recent authors: Snodgrass (1948), Hughes (1949), and Gorirossi (1950) (table 1). The structures themselves have been compared to those found in other forms and some attempt to unravel homologies has been made. In selecting terms appropriateness, usage, and clarity have been considered to be of more importance than priority. While the usage reported in this paper (table 1) indicates to some degree the extent of confusion in terminology, an even better understanding can be achieved by consulting the table in Hughes (1949).

Certain terms appear to have been fixed by modern usage, or have presented no problem even in the past. These are: "pharynx," "mouth," "labrum," "chelicerae," and "pedipalps."

Other terms present little difficulty. "Gnathosoma" is the term currently most frequently used in designating the region that bears the mouth parts of mites. It is a companion term of the modern method of designating the body regions of the mites into: gnathosoma, propodosoma, metapodosoma, opisthosoma, etc. "Capitulum" is frequently used to refer to the same region of the ticks. It is true that "gnathosoma" is somewhat inappropriate since jaws are not present in the Acarina, but on the other hand, "capitulum" is equally inappropriate since most of the cephalic structures are not contained in it. "Gnathosomal base" is used here for internal consistency despite the fact that modern usage has settled on "basis capituli." The term "gnathosomal setae" has been adopted for the same reason. The subcheliceral plate has been recognized as that portion of the transverse gnathosomal shelf that serves to anchor the internal cheliceral sheaths and to give origin to the epipharyngeal muscles. The epistome is that portion of the shelf that supports the labrum and serves as the origin of the pharyngeal dilators. The tentorium is that portion of the shelf that connects its central elements to the mesial walls of the pedipalpal coxae. These three terms have been found to be convenient in talking and thinking about three interconnected structures that had previously been considered as a single structure. Two cheliceral sheaths are present in the Mesostigmata. One sheath is an apodeme and has been called an internal cheliceral sheath despite the fact that it is the outermost sheath if the chelicerae are considered as the central elements. The other sheaths is an elongated synarthrodial membrane, one surface of which is external. Therefore, despite the fact that this sheath immediately surrounds the chelicerae it is called the external cheliceral sheath. Little confusion concerning the modern applicability of the term "epipharynx" has arisen recently except that Hughes (1949) has named the walls of the epipharynx as distinct structures: *paralabra interna* and *paralabra externa*. Snodgrass (1948) in discussing a description (Stanley, 1931) of *Echinolaelaps echidninus* indicates that he considers the epipharynx to be merely a ventral lobe of the labrum. The term "hypostome" has long been used for the anterior ventral prolongations of the gnathosomal base as well as for a median ventral element of the

base itself. Here, "hypostome" refers only to the components that arise laterally from the gnathosomal base. Hypostomal setae are the three pairs of setae found on the ventral wall of the hypostome. Hypostomal processes are projections of the hypostome that frequently arise just distal to the distal hypostomal setae. The term corniculi has enjoyed wide usage (Vitzthum, 1929) and applies to hornlike projections that arise from the dorsal wall of the hypostome, lateral to the hypostomal processes. These projections have also been called "maxillae" in the past, but since they are not homologous with other arthropod maxillae the term has not been adopted.

A few of the terms used here must be discussed in some detail. The term "tectum" as used by Snodgrass for the dorsal, anterior, median projection of the gnathosomal base does not have wide usage. This structure has been called the epistome for many years by many authors. Snodgrass uses "epistome" for the plate from which the pharyngeal dilators originate and the labrum arises. The epistome is so defined in the insects and there is no reason why it should not apply equally well to the mites. Snodgrass' terminology has, therefore, been followed here. "Hypopharynx" as used here refers to anterior extensions of the ventro-lateral pharyngeal walls. That these walls are in reality pharyngeal walls is emphasized by the fact that they are equipped with dilator muscles that are similar to the pharyngeal dilators in every respect. Since this structure obviously has a different origin than the hypostome and since it appears to be a derivative of the ventro-lateral pharyngeal walls, the term hypopharynx seems particularly apt. Anterior projections of the hypopharynx have been called hypopharyngeal processes. A pair of styli near the base of the hypopharynx have been called hypopharyngeal styli to differentiate them from other types of styli found in mites other than *Megisthanus floridanus*. In other mites hypopharyngeal, epipharyngeal, and salivary styli have been found. Salivary styli can be recognized by the fact that they bear the openings of the salivary ducts. The other styli can be recognized by their position.

Two terms remain to be discussed that can best be considered together. These are "deutosternum" and "protosternum." In the mesostigmatid mites there is present at the base of the gnathosoma an emergent plate that most frequently resembles a large bifid seta. This structure is universally recognized as the tritosternum, or the primary sternite of the third embryonic segment. Anterior to the tritosternum, there are two mid-ventral plates on the gnathosoma that have a different texture, and are more or less distinctly set off from the lateral elements of the gnathosoma. These lateral elements may be derived from the pedipalpal coxae. It is probable that the median elements have a different origin. Possibly their origin is similar to the origin of the tritosternum. It is for these reasons that the anterior plate is called protosternum, while the posterior plate is called deutosternum. Embryological studies will be required to determine whether or not these terms should be considered as being applicable with their full significance.

SUMMARY

A system of nomenclature for the structures that make up the gnathosoma of mesostigmatid mites has been developed. Using *Megisthanus flori-*

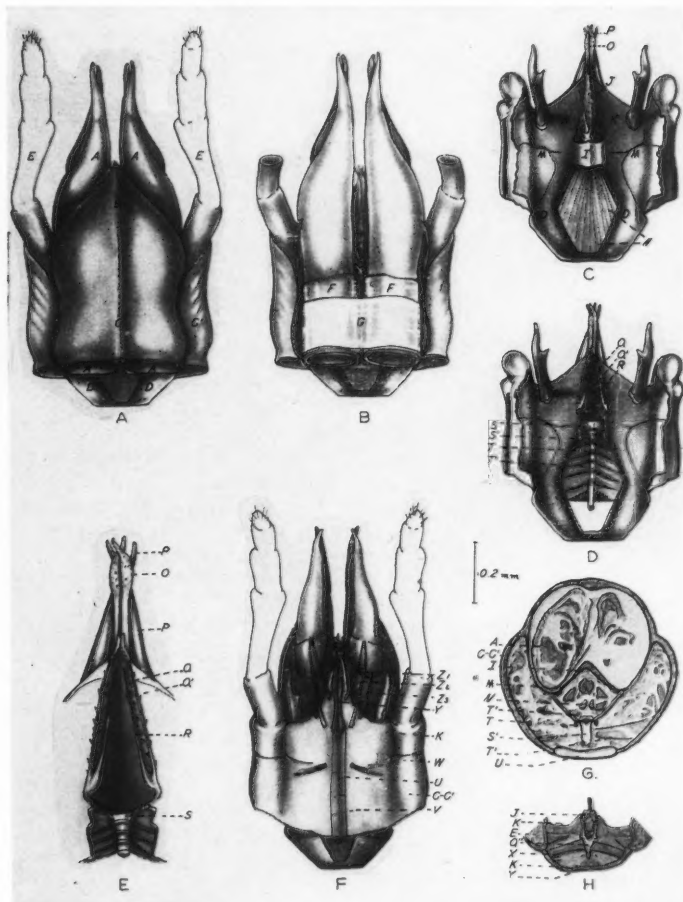


Plate I. A. Dorsal view of gnathosoma of a female *Megisthanus floridanus*; B. Fig. A with tectum and dorsal wall of gnathosomal ring removed; C. Fig. B with chelicerae and cheliceral sheaths removed; D. Fig. C with epipharyngeal muscles, epistome, labrum and epipharynx removed; E. Detail of anterior median region of fig. D; F. Ventral view of gnathosoma; G. Cross section through base of gnathosoma at level of epistome; H. Cross section through gnathosoma at level of hypostome to show relationship of epipharynx to hypopharynx. Figures A-F were drawn by A. Hansens from actual dissections by Miss Gorirossi. Figures G-H are photographs of sections made at 10 micra. Scale is applicable to all figures.

LEGEND: A.—chelicerae, B—tectum, C.C.—gnathosomal base-ring, D—subcheliceral plate, E—palps, F—external cheliceral sheaths, G—internal cheliceral sheaths, H.—

danus as a model, the structures have been described and the terms defined on the basis of this description. A synonymy of terms restricted to three recent reports is included.

REFERENCES

- BÖRNER, C. 1902—Arachnologische studien. V. Die Mundbildung bei den Milben. Zool. Anz. 26:99-109.
- GORIROSSI, FLORA E. 1950—The mouth parts of the adult female tropical rat mite, *Bdellonyssus bacoti* (Hirst, 1913) Fonseca, 1941 [= *Liponyssus bacoti* (Hirst)], with observations on the feeding mechanism. J. Parasit. 36:301-317.
- HUGHES, T. E. 1949—The functional morphology of the mouth-parts of *Liponyssus bacoti*. Ann. Trop. Med. Parasit. 43:349-360.
- OUDEMANS, A. C. 1928—Fauna Buruana Acari. Treubia 7: (suppl. pt. 2) 37-100.
- PEARSE, A. S., MARGUERITE T. PATTERSON, JOHN S. RANKIN AND G. W. WHARTON 1936—The ecology of *Passalus cornutus* Fabricius, a beetle which lives in rotting logs. Ecol. Mono. 6:455-490.
- SNODGRASS, R. E. 1948—The feeding organs of Arachnida, including mites and ticks. Smithsonian Misc. Coll. 110:61-80.
- STANLEY, J. 1931—Studies on the muscular system and mouth parts of *Laelaps echidninus* Berl. Ann. Ent. Soc. Amer. 24:1-12.
- VITZTHUM, H. G. 1929—Acari, in Die Tierwelt Mitteleuropas. Vol. 34, Sec. 7:1-112 + 12 plates. Leipzig.
- WINKLER, W. 1886—Anatomie der Gamasidae. Arb. Zool. Inst. Univ. Wien 7:317-354.

labrum, I.—epistome, J.—epipharynx, K.—hypostome, L.—corniculi, M.—region of tentorium, N.—epipharyngeal muscles, O.—hypopharyngeal processes, P.—hypostomal processes, Q.—sides of hypopharynx, Q'—floor of hypopharynx, Q''—hypopharyngeal groove, R.—hypopharyngeal styli, S.—dorsal wall of pharynx = epipharynx, S'—pharynx, T.—pharyngeal constrictor muscles, T'—pharyngeal dilator muscles, U.—deutosternum, V.—teeth of deutosternum, W.—gnathosomal setae, X.—hypostomal dilators, Y.—protosternum, Z1, 2, 3.—distal, medial, lateral hypostomal setae.

Notes on the Amphibians and Reptiles of Crater Lake National Park*

Donald S. Farner

State College of Washington, Pullman

James Kezer

University of Missouri, Columbia

Crater Lake National Park encloses an area of approximately 250 square miles of relatively high country lying on both sides of the Cascade Divide in southern Oregon. The lake occupies the caldera of Mount Mazama, an extinct Pleistocene volcano. The mean elevation of the surface of the lake is about 6100 feet. The walls of the caldera vary in elevation from 6718 feet at the Wineglass talus slope to 8156 feet at the summit of Hillman Peak. The highest elevation in the Park is the summit of Mount Scott (8938 ft.) near the East Boundary; the lowest elevation (3977 ft.) is in the southwest corner in Red Blanket Creek Canyon. The northeast quadrant of the Park is covered deeply with pumice; this, and its position on the east side of the Cascade Divide, make it the driest part of the Park. Only one small stream, Bear Creek, has its origin in this quadrant. The southeast quadrant contains Wheeler, Sand, Sun, and Annie creeks, all of which flow through canyons with varying amounts of wet meadows; like Bear Creek, they are a part of the Klamath Drainage. The streams of the southwest and northwest quadrants, Red Blanket, Castle, Copeland, Bybee, Crater, and National creeks, generally arise from springs in wet meadows and have cut canyons of varying depths and with varying amounts of wet meadows on their sides and floors. These streams flow generally westward into the Rogue River drainage. Boundary Springs, the headwaters of the Rogue River, lie at the northwest corner of the Park. A small area in the northern part of the Park drains into the Umpqua system; but this area contains no permanent streams.

The mean annual precipitation at Park Headquarters (6475 ft.) is slightly less than 70 inches. However, because most of this comes as snow during the winter, and also because of the porous nature of the pumice cover and the soil derived therefrom, the vegetation of the area does not reflect a rainfall of this magnitude. Mean air temperatures are relatively moderate for these elevations. The mean maxima and minima for the coldest months, January and February, are 31.4° F., 31.6° F., 18.4° F., and 18.8° F., respectively. The warmest months, July and August, have mean maxima and minima of 65.8° F., 69.8° F., 42.5° F., and 42.3° F., respectively.

The geology has been described in detail by Williams (1942). In general it is an area of Pliocene and Pleistocene volcanoes that have become quiescent during the last thousand years or so. The numerous recent cinder-cone volcanoes and the partially eroded older and larger volcanoes were eclipsed in size by Mount Mazama, which was probably comparable in size to Hood and Shasta. The last activity of Mount Mazama proper consisted of an

* Most of the investigations on which this paper is based were made while the authors were members of the temporary naturalist staff of Crater Lake National Park.

eruption of pumice and scoria that removed about five cubic miles of material; another 1.5 cubic miles of old rock were removed by explosive action; in addition to the material lost by the eruption, there was apparently a further loss of eleven cubic miles of magma by downward withdrawal. The result of this total loss of about 17 cubic miles of material from its core was the collapse of approximately the upper 4000 feet of the volcano thus forming the caldera. The analysis by Arnold and Libby (1951:7) of the carbon 14 in the logs carbonized during the pumice eruption indicates that the eruption must have occurred approximately 6000-7000 years ago. Following the collapse of Mount Mazama a series of eruptions from the floor of the caldera produced a cinder-cone volcano known as Wizard Island that now extends about 800 feet above the surface of the Lake.

The lake* is of unusual depth, the maximum sounding being 1996 feet; the average depth is about 1500 feet. The shore line is composed predominately of large fragments of volcanic rock, mostly andesite; there are few shallow areas and no littoral zone in the ordinary sense of the word. The water is remarkably clear as indicated by the occurrence of *Fontinalis* and *Drepanocladus* at depths of about 400 feet (Hasler, 1938:95). Various aspects of the limnology of the lake have been discussed by Evermann (1897), Kemmerer *et al.* (1923), Brode (1938), Hasler (1938), Hasler and Farner (1942), and Utterback, Phifer, and Robinson (1942). In general it may be characterized best as an extremely oligotrophic montane lake. All water from 100 meters depth to the bottom is at approximately 4° C. or less (Hasler, 1938:95; Utterback *et al.*, 1942:98). There are no surface outlets; the surface inlets are trivial, consisting of a few short streams leading from springs in the walls of the caldera. Fishes were first introduced by William Gladstone Steel in 1888; more or less regular stockings were made by the National Park Service from 1909 through 1939. In recent years it has become obvious that the populations (Wallis and Bond, 1950) of *Oncorhynchus nerka* and *Salmo gairdnerii* are maintaining themselves by natural reproduction against some fishing pressure. Despite its low productivity the lake has supported normal fish growth (Hasler, 1938; Hasler and Farner, 1942).

With the exception of the dry open pumice flats, a few areas of chaparral, and the wet montane meadows, the slopes of Mount Mazama are covered with well-developed forests. At the lower elevations, generally up to about 5500 feet depending on exposure, are the so-called Transition Zone forests consisting of pure stands of *Pinus ponderosa* on the arid east slopes, shifting gradually to a mixture of *Pinus ponderosa* and *Abies concolor* with clumps of *Ceanothus velutinus* and *Arctostaphylos patula*, on the southeast and south slopes, finally to a mixture of *Pseudotsuga taxifolia*, *Pinus ponderosa*, *Abies concolor*, and *Pinus lambertiana* on the more humid southwest and west slopes. Above these, on slopes up to approximately 6000 feet lies the belt of *Pinus contorta latifolia*; in most areas this species occurs in pure stands; at some localities there are varying amounts of *Abies magnifica shastensis* and *Pinus monticola*. At about 6000 feet, in accordance with exposure, the lodgepole pine forests are replaced by pure stands of *Tsuga mertensiana*, less frequently of *Abies magnifica shastensis*, or more commonly mixtures of these

* References to "the lake" refer throughout to Crater Lake.

two. These forests are fairly humid and park-like with little undergrowth; near the upper limits the firs disappear and occasional white-bark pines may be seen. The forests of highest elevation are those of *Pinus albicaulis*. Usually they are quite open with intervening areas of dry pumice flats which support only a sparse arid flora.

Along many of the streams and around most of the springs are varying amounts of montane meadow. Usually these contain spring pools and frequently isolated ox-bow pools. The latter are commonly inhabited by the larvae of *Bufo boreas*, *Rana cascadae*, *Hyla regilla*, and *Ambystoma macrodactylum*. The meadows usually have clumps of *Salix*, a rich cover of forbs and sedges, and a border of *Abies lasiocarpa*.

Although Crater Lake was apparently first seen by white men in 1853, it was not until after 1865, when a military road was constructed from Fort Klamath to Jacksonville and passed near Annie Spring, that it became well known. Efforts to establish a national park began quite early and in 1888 the land now in the Park was withdrawn from public sale; in 1902 the National Park was established. Prior to the establishment of the National Park there was some grazing and hunting in the area. Any effects of these activities seem to have disappeared some time ago. Actually, it appears doubtful that there have been any cultural influences that could have altered the herpetological fauna in any appreciable way. The only possibility might be the introduction of predacious fishes into the Lake. The rather extensive investigations of their food habits (Hubbard, 1933; Brode, 1935, 1938; and Hasler and Farner, 1942), however, indicate this to be a very minor influence since very few of the fishes take amphibians as food.

Since the first herpetologic observations by Evermann (1897) in 1896, there have been frequent references to the amphibians and reptiles of Crater Lake National Park in the literature. Of these, only two (Campbell, 1929; and Vincent, 1947a) have dealt with the entire herpetologic fauna; these two treatises have had very limited distribution. The annotated list of the reptiles and amphibians of the Rogue River basin, prepared by Fitch (1936), refers to most of the species occurring in the Park but, because of the extensive area involved, lacks details on distribution and ecology within the Park. During the past ten years we have gradually accumulated considerable numbers of specimens and observations that have increased our knowledge of the reptiles and amphibians of this interesting high-elevation area.

Most of the specimens to which references are made are in the Crater Lake National Park Zoological Collection and are indicated by the abbreviation CLNP. Specimens in other collections are indicated as follows: University of Kansas Museum of Natural History, KUMNH; Museum of Vertebrate Zoology, University of California, MVZ; Charles R. Conner Museum, Washington State College, WSC; U. S. National Museum, USNM; and Stanford University, SU. In general only localities within the Park are included except in cases in which comparisons with nearby localities are desirable. The synonymy given for each form includes only names that have been applied to material from the Park. The locality names are from the United States Geological Survey topographic map, "Crater Lake National Park and Vicinity, Oregon." Edition of 1946.

TRITURUS GRANULOSUS GRANULOSUS (Skilton)—Oregon Newt

Our knowledge of the occurrence of this newt in Crater Lake National Park is based on three specimens collected from two localities. A single large adult (CLNP 435) was collected on August 25, 1951, in a cut-off

oxbow along Munson Creek (6230 ft.). It is of interest to note that this locality is only two and one-half miles from Crater Lake (6160 ft.) where only *T. g. mazamae* occurs. These two localities are separated by Garfield Peak whose elevation is 8060 feet. Our two other specimens (CLNP 509) were collected on September 22, 1951, in a bog pond about one-half mile south of Crater Spring (5300 ft.), a distance of about six miles from Crater Lake.

In the vicinity of the Park we have found typical *granulosus* to be very abundant at Spruce Lake (4750 ft., Jackson County, CLNP 449, 459), which is only one and one half miles west of the Park in the Rogue River Drainage, and (CLNP 379) in a cut-off oxbow on the Rogue River (about 4000 ft.) near Hamaker Meadows in Douglas County. Campbell (1934:1) records *Triton torosus* from the beaver ponds on Copeland Creek. We have been unable to secure any specimens from this locality, but Crater Spring, and also of the proximity of the Copeland Creek ponds to in view of our specimens from Munson Meadow and the bog pond near Spruce Lake, it appears highly probable that Campbell's record is assignable to typical *granulosus*.

TRITURUS GRANULOSUS MAZAMAE Myers—Mazama Newt

Triturus torosus, Slevin (1928:22, 24); Campbell (1934:1); Brode (1938:52). *Triturus similans*, Fitch (1936:635); Gordon (1939:51). *Triturus granulosus mazamae*, Myers (1942:80); Bishop (1943:74); Pickwell (1947:5); Farner (1947:259); Vincent (1947a:19); Funkhouser (1949:13).

It is of interest to note that this distinctive newt apparently was not found by Evermann (1897) in 1896. The first published record, to the best of our knowledge, is that of Slevin (1928). It has been noted as common along the lake shore by Campbell (1934:1), Heath (ms, 1938) in 1938 and Farner (1947:259) in 1946. The abundance of the semi-terrestrial individuals found beneath the rocks is certainly variable. Vincent (1947a:19) apparently found none during the summer of 1947. Although they were abundant during the summer of 1950, very few were seen during the summer of 1951. To the best of our knowledge this subspecies is confined to Crater Lake. Although most of the specimens and observations are from Eagle Cove, Wizard Island and Skell Channel, there are sufficient observations and specimens from elsewhere to indicate that this interesting newt has a general distribution about the lake.

Our knowledge of the life history of the Mazama newt is incomplete. The smallest larvae that we have found in the lake were collected in the pool behind the Government Boathouse on Wizard Island during the first week of September, 1951 (CLNP 452, 498, 499). The total lengths of ten of these larvae vary from 18 to 24 mm. with a mean of 21.6 mm. Closely related newts, developing in warmer water, attain this length in about three weeks after leaving the egg mass; development in the colder water of the lake almost certainly would be sufficiently slower to require caution with respect to conclusions based on the rate of growth of other newts. Nevertheless, it seems probable that the eggs from which these larvae came had been deposited during the summer, perhaps back in the spaces between the large blocks of lava where they would be entirely inaccessible.

In the water along the shore and in pools partially separated from the lake, larvae (CLNP 442, 443, 444) from about 65 to 95 mm. total length may be found during the summer months. The mean length for 16 of these larval newts is 81 mm. Our limited data suggest that the small larvae observed in the pool behind the Government Boathouse on Wizard Island attain this size during their second season of growth, undergoing metamorphosis at that time. Associated with the large larvae may be found newly metamorphosed newts and adults of various sizes, including large, mature individuals (CLNP 369, 387, 436, 437, 442), which vary in total length from about 130 to 200 mm. The mean for 27 specimens is 168 mm.

It is interesting to note that the *Mazama* newts are by no means confined to the actual water of the lake but may frequently be collected in large numbers under the rocks and driftwood along the shore, often in association with *Ambystoma macrodactylum*. In this non-aquatic environment they appear desiccated and sluggish with highly granular skin. Our collections of these semi-terrestrial individuals (KUMNH 2350-1, 23511-9, and 7 uncatalogued specimens—460727, D. S. Farner) show that all sizes of newts from newly metamorphosed to large adults may display this behavior. In a lot of 20 specimens, total lengths vary from 75 to 180 mm. We have considered the possibility that these semi-terrestrial individuals represent a definite stage in the life history of this newt; however, since no single size group is involved, it seems more probable that a transitory semi-terrestrial existence may develop at almost any time in the life cycle beyond metamorphosis.

On several different occasions we have observed large aggregations of *mazamae* along the shore of the lake. Usually these aggregations of newts consist of semi-terrestrial individuals in groups of about twelve to fifteen out of the water and under rocks or pieces of driftwood. A somewhat different kind of aggregation was observed on September 6, 1951, on the east side of Eagle Point where the shore of the lake consists of a rocky beach covered with willows. Two hundred and fifty-nine newts (CLNP 501 through 507) were massed together in an area of water not more than thirty feet square, the vast majority of these being under a single flat rock about nine feet square, resting on other rocks in approximately one foot of water. This aggregation of newts consisted of large larvae, newly metamorphosed individuals and adults of varying sizes. The mean total length for all of the metamorphosed individuals is 155 mm. An interesting aspect of this collection consists of 16 individuals (149 mm. mean total length) having varying amounts of external gill tissue. None of these has as much gill tissue as an ordinary newt larva but in all of them a certain amount of this larval respiratory tissue remains unabsorbed. These odd individuals are apparently similar to four observed by Bishop (1943).

An examination of a substantially larger series of specimens confirms the diagnostic characters recorded by Myers (1942:80) in his description of this form. The ventral pigmentation, particularly striking on the limbs, occurs consistently on all adults of *mazamae* and is absent from all collections of typical *granulosus* which we have made in adjacent areas. The ventral pigmentation on the larvae and newly metamorphosed occurs less frequently and

less strikingly. It is of interest to compare measurements of adult *mazamae* with adults of typical *granulosus* from nearby areas (Table 1.).

TABLE 1.—Comparison of Adult Measurements for *Triturus granulosus granulosus* and *Triturus granulosus mazamae*

	Number of specimens	Mean total length (mm.)	Standard deviation (mm.)	Mean length to anterior lip of cloaca (mm.)	Standard deviation (mm.)	Ratio—total length to cloaca
<i>mazamae</i>						
Crater Lake ¹	27	168	18	71	6.9	2.4
typical <i>granulosus</i>						
Upper Rogue River ²	20	176	13	73	4.3	2.4
typical <i>granulosus</i>						
Spruce Lake ³	25	169	15.5	70	3.9	2.4
typical <i>granulosus</i>						
Munson Meadow ⁴	1	205		81		2.5
typical <i>granulosus</i>						
Bigelow Lakes ⁵	15	190	18	75	3.5	2.6
typical <i>granulosus</i>						
near Crater Spring ⁶	2	173		72		2.4

¹ CLNP 369, 387, 389, 436, 437, 442. ² Cut-off section near Hamaker Meadow, 4000 ft., Douglas County, Oregon. CLNP 379. ³ 4250 ft., Jackson County, Oregon. CLNP 445, 459. ⁴ 6300 ft., Crater Lake National Park. CLNP 435. ⁵ 5600 Josephine County, Oregon. CLNP 438. ⁶ 5300 ft., 1/2 mile south of Crater Spring, Crater Lake National Park. CLNP 438.

Obviously no distinction can be made between *mazamae* and typical *granulosus* on the basis of size or tail-body proportion.

It should be noted that the designated type locality "near Crater Lake on the higher slopes of Mt. Mazama" is somewhat misleading since the specimens must have been taken, according to the manuscript notes of the collector, Dr. James P. Heath, along the shore of the lake, hence on the inner walls of the caldera of Mt. Mazama. This is an important distinction since, on the "slopes" of Mt. Mazama we have found typical *granulosus* at Munson Meadow (6300 ft.), in a bog pond near Crater Spring (5300 ft.), at Spruce Lake (4250 ft.), and along the upper Rogue River (4000 ft.). These collections of typical *granulosus* also appear to make improbable the suggestion of Myers (1942:81) and Pickwell (1947:5) that *mazamae* occurs elsewhere in the high Cascades.

According to Farner (1947) the semi-terrestrial individuals apparently leave the rocks and enter the water to feed. The species is essentially predacious as indicated by the consistent occurrence of an amphipod *Hyalella azteca* (Saussure) in its stomach; snails, aquatic insect larvae, and a few terrestrial arthropods are also taken. This salamander is preyed upon occasionally by rainbow trout (Vincent, 1947a:19). Doubtless some of the salamanders described by Hubbard (1933), Brode (1938) and Wallis (1947) as food by

fish were specimens of this newt. On September 1, 1948, a garter snake, *Thamnophis sirtalis fitchi* was taken on Wizard Island with a half-swallowed *Mazama* newt in its mouth.

AMBYSTOMA GRACILE Baird—Northwestern Salamander

One of the interesting experiences of the 1951 season was the discovery of this species in the Park. Assisted by Lawrence Bisbee and Fred Larmie on September 15, 1951, we found large neotenic individuals occupying small bog ponds in the vicinity of Crater Spring at 5300 feet. This remote and seldom-visited northwestern portion of the Park is characterized by wet montane meadows and sphagnum bogs that extend about one-half of a mile along either side of Crater Creek from its origin at Crater Spring. The boggy area to the south of Crater Creek contains three ponds that abound with *Ambystoma gracile*. Two of these ponds are small, not more than six feet in diameter, but the third is larger—about 25 feet long and 10 feet wide. Each pond is surrounded by a floating mat of vegetation and the sides drop off almost vertically to a depth of from four to six feet. From these three small bodies of water, we have collected nine large neotenic larvae (CLNP 480, WSC 51-287, WSC 51-288), which have a mean total length of 165 mm. (snout to cloaca mean length 79.3 mm.) and smaller larvae (CLNP 476), which fall into two size classes. The 12 larvae that make up the smaller of the two size groups range in total length from 23 mm. to 31 mm. with a mean of 25.8 mm. The single larger larva has a total length of 56 mm.

Along the northern side of Crater Creek, this species occupies a bog pond that is almost filled with vegetation. This is a roughly circular body of water about 120 feet in diameter, surrounded by an extensive floating mat of vegetation extending into the pond as its bottom. Sedges and aquatic plants protrude from this floating mat through the water surface, leaving only small patches of open water. Large larvae were seen in this pond; our collection consists of two smaller individuals (CLNP 510) with total lengths of 109 mm. (54 mm. snout to cloaca) and 79 mm. (38 mm. snout to cloaca).

In the vicinity of the Park we have collected this species in Douglas County in a cut-off section of the Rogue River below Hamaker Meadows at 4000 feet (CLNP 508—large neotenic larva) and at Spruce Lake (CLNP 453, 454, 489, 473, 479, 483, 486) in Jackson County near the west boundary. Our several visits to Spruce Lake during the first two weeks of September, 1951, revealed an *A. gracile* population made up of large neotenic larvae, smaller larvae of several size classes, metamorphosing larvae and completely metamorphosed individuals.

In each of the four localities where we have collected this species, its globular egg masses have been conspicuous. On July 25, 1951, in the cut-off portion of the Rogue River, we found that hatching had already taken place in some of the egg masses but in others the embryos were present in the gel. At Spruce Lake on August 31, 1951, at least 150 masses of gel were seen, hatching having taken place sometime prior to that date. We were extremely interested to find on September 22, 1951, in a bog pond along the northern side of Crater Creek, an egg mass of this species containing well-developed embryos (CLNP 511). This unhatched egg mass, along with the

various size groups of small larvae that we have found in Spruce Lake and in the bog ponds near Crater Creek, indicate a long egg-laying season for this species.

AMBYSTOMA MACRODACTYLUM MACRODACTYLUM Baird—Long-Toed Salamander

Ambystoma macrodactylum, Evermann (1896:235). *Ambystoma macrodactylum*, Campbell (1931); Fitch (1936:636); Brode (1938:52); Slevin (1938:29); Gordon (1939:53); Bishop (1943:139); Farner (1947:259); Funkhouser (1949:13). *Ambystoma macrodactylum* [sic], Vincent (1947a:19). *Ambystoma macrodactylum macrodactylum*, Mittleman (1948:93).

This species occurs abundantly in the adult stage beneath the rocks and logs at the water line of the lake; it occurs much less abundantly at other suitable localities in the Park. Its abundance along the shore of the lake was first described by Evermann (1896:235) who found it beneath Red Cloud Cliff, in Eagle Cove, and on Wizard Island; he collected more than 100 specimens (USNM 39549-163 etc., 39880, 39881) and noted that many more could have been taken. Since that time this abundance has been noted by Campbell (1931:1), Slevin (1938:29-30), Heath (1938), Farner (1947:259), Vincent (1947a:19), and Funkhouser (1949:13).

Our own observations also have shown the adults to be extremely abundant beneath the rocks and driftwood at the water line. As an example of their abundance, one of us collected 45 adults (CLNP 372) of this species in 30 minutes, on August 4, 1951, along 100 yards of shore line in Eagle Cove; thirteen were under a single flat rock with a surface of about 1.5 square feet. Larvae are found less abundantly in the water among the rocks along the shore.

Elsewhere in the Park, this species has been found at the Beaver Ponds on Copeland Creek by Campbell (1934:1) and in Munson Meadow by Vincent (1947:19). The larvae noted by Heath (ms, 1938) in a pond on Whitehorse Bluff in August, 1938, doubtless were of this species. We have records from Munson Meadow (CLNP 402, 403, 423, 427—adults and larvae), Whitehorse Bluff (CLNP 383, 426, 439, 450—adults and larvae), headwaters of National Creek (CLNP 382—adults and larvae), Boundary Springs (CLNP 58—one adult), cut-off portion of Wheeler Creek at 5570 feet (CLNP 424—larvae only), cut-off portion of Red Blanket Creek at 5550 feet (CLNP 471—larvae only) and from a pond southeast of Arant Point (CLNP 477—larvae and an adult).

In the vicinity of the Park, we have collected this species from the Williamson River (Klamath County) near Kirk (CLNP 386—metamorphosing larvae), from a cut-off section of Miller Creek (Klamath County) near Miller Lake (CLNP 365—larvae), Spruce Lake in Jackson County (CLNP 482—adults and larvae), and from Lake West in Douglas County (CLNP 62, 371, 449—larvae, metamorphosing larvae and adults). Newly metamorphosed adults of this species become extremely abundant in and under woody debris around the shoreline of Lake West during the time that metamorphosis is taking place. Although we were able to find only four adults around this lake on July 19, 1951, hundreds of newly metamorphosed individuals were seen on August 30. Larvae in varying stages of metamorphosis were

also abundant in the shallow water at the shoreline on this date. On September 4, 1948, it was not unusual to find in excess of 100 young adults in a single rotted log. On September 6, 1949, 108 were found beneath a single 12-foot board.

Our knowledge of the life history of this species in the Park is somewhat fragmentary. During the 1951 season, we attempted to increase our understanding of this life history by periodic visits to some of the bodies of water in which we had found *macrodactylum* larvae. The larval salamanders inhabiting a small temporary pond on Whitehorse Bluff (6250 ft.) interested us particularly because the temporary nature of this pond suggested that these salamanders had come from eggs deposited during the spring of 1951. When we first visited this pond on July 22, it had a maximum depth of about three feet and an area of approximately 5100 square yards. In addition to an abundant population of larval *Ambystoma macrodactylum*, the pond contained various aquatic insects and fairy shrimp, *Streptocephalus*. Ten of the salamander larvae collected during this visit (CLNP 383, 22 July 1951) had a mean length of 32.1 mm. By the 9th of August, the pond had decreased considerably in size and the five larvae collected at this time (CLNP 439) had grown to a mean length of 45.8 mm. By the 19th of August, the pond had shrunk to a small puddle having a surface of about 30 square yards. Only a few inches of water remained and the salamander larvae were thickly aggregated in this small area, resting in and upon the mud. The area was thoroughly searched for metamorphosed individuals, but none could be found in the moist, rotting logs that abound in the vicinity of the pond. Ten larvae collected on this date (CLNP 426) had a mean length of 47.4 mm. A final visit was made to this pond on the 29th of August. During the intervening ten days, it had dried up and had then partially refilled with water from the rain and snowfall of August 28. The dead remains of salamander larvae were conspicuous on the muddy surface of the re-formed puddle. A thorough search of the moist woody debris in the vicinity revealed five recently metamorphosed salamanders of this species (CLNP 450), two of which still possessed short, unabsorbed gill filaments. The mean length of these five metamorphosed specimens was 47.8 mm.

The observations on Whitehorse Bluff suggest a relatively simple life history, with egg deposition as soon as the pond water becomes available in the spring and metamorphosis late in the summer. Observations made in permanent bodies of water indicate that the life history does not always follow this simple pattern. In a pool in Munson Meadow (6230 ft.) we have simultaneously collected adults (CLNP 402, 423) and larvae of two sizes. The smaller larvae (CLNP 403, 17 August 1951, and CLNP 427, 25 August 1951) vary in total length from 25.3 mm. to 37.8 mm. in a trimodal distribution suggestive of three separate egg groups. The single large larva (CLNP 402, 17 August 1951) has a total length of 93.4 mm. This is very similar to the length (88.4 mm.) of an adult (CLNP 423, 25 August 1951) taken at the same pool, and to metamorphosing larvae from the lake (CLNP 372, 21 July 1951) and from Williamson River (CLNP 386, 11 July 1951). We interpret this large larva as evidence for the possibility of a two-season larval life in the life history of this salamander. Furthermore, it seems probable

that the smaller larvae in the Munson Meadow pool in 1951 would not metamorphose until sometime after the thawing of this pool in 1952, inasmuch as they showed no signs of metamorphosis on the 20th of September, at most only a few weeks before heavy snows may be expected in the Park.

Two sizes of larvae have been collected from the lake. The smaller of these two size groups consists of two individuals collected during the first week of September, 1951, in a partially cut-off pool on Wizard Island behind the Government Boathouse (CLNP 451). These two *macrodictylum* larvae have a mean length of 41.5 mm. Elsewhere in the lake we have found only large (about 90 mm.) larvae. These are equivalent in size to the adults found beneath the rocks and have been taken throughout July, August, and September in various stages of metamorphosis. Series collected on July 21, and August 4, 1951 (CLNP 372, 367), are typical of the large larvae, metamorphosing individuals and adults that constitute the population of this species as it is commonly observed along the shore of the lake. We believe that these data indicate a two season larval life for the long-toed salamanders that live in the lake.

A number of tentative conclusions may be drawn from these observations. (1) This species of salamander may complete its life cycle from egg through metamorphosis in a single season of about two months as shown by the individuals in the temporary pond on Whitehorse Bluff. (2) In permanent pools, such as the one in Munson Meadow, the larval life may extend through two seasons. (3) The large, metamorphosing larvae of the lake indicate that in that body of water two seasons are consistently required for growth through metamorphosis. (4) The various size groups of larvae, conspicuous in the permanent pools outside the lake suggest a long egg-laying season. Certain of these conclusions verify the observations of Slater (1936). Moreover, with the exception of the lake, the habitats in which we have found larvae are similar to those described by him.

Hubbard (1933), Brode (1938), and Wallis (1947) note that Crater Lake fish take a small number of salamanders as food; unfortunately the species involved is not noted. According to Farner (1947:260), the adult *Ambystoma macrodictylum* obtain food primarily by scavenging. The bulk of the food was found to consist of terrestrial arthropods; some aquatic insect larvae were also taken.

ENSATINA ESCHSCHOLTZII OREGONENSIS (Girard)—Oregon Red Salamander

The occurrence of this salamander in Crater Lake National Park is known only from a single specimen (CLNP 390) found beneath a pile of boards near Annie Spring (about 6080 ft.) on August 7, 1951, by Lawrence Bisbee. Although allocated to *oregonensis* the specimen is actually intermediate between *oregonensis* and *platensis* (Espada) according to the revision of Stebbins (1949).

ASCAPHUS TRUEI TRUEI Stejneger—Northwestern Ribbed Frog

Ascaphus truei, Campbell (1934:1). *Ascaphis truei* [sic], Vincent (1947a:20). *Ascaphus truei truei*, Mittleman and Myers (1949:62).

This distinctive species is known only from three streams in the western portion of the Park. Berry Campbell collected it from Bybee Creek on July

3, 1934 (USNM 95226-9), and on July 25, 1935 from Copeland Creek (USNM 95230-1). James P. Heath obtained specimens (SU 3920) from Castle Creek on September 10, 1938. With the assistance of E. J. Bucknall and Lawrence Bisbee, on August 8, 1951, we were able to obtain one larva, one adult female, and three adult males (CLNP 350, 351, 352) from Bybee Creek (5800 ft.). Our attempts to find it elsewhere in the Park have been unsuccessful.

BUFO BOREAS BOREAS (Baird and Girard)—Northwestern Toad

Bufo boreas boreas, Campbell (1934:1); Fitch (1936:639); Gordon (1939:60); Vincent (1947a:21); Funkhouser (1949:13).

This toad is moderately common throughout the Park up to elevations of about 7000 feet. Larvae may be found in considerable abundance along the lake below Hillman Peak, and in Eagle Cove, in pools in Munson Meadow, and in Annie Creek Canyon. We have adult specimens from Garfield Peak Trail (7090 ft., CLNP 357), Rim Village (7076 ft., CLNP 358), Wizard Island (CLNP 54), Annie Creek Canyon (5400 ft., CLNP 14), Eagle Cove (CLNP 353), Boundary Springs (5350 ft., 394), and the lakeshore beneath Hillman Peak (CLNP 456). We have larval specimens from Annie Creek (4500 ft., CLNP 462), Eagle Cove (CLNP 461), lakeshore beneath Hillman Peak (CLNP 456), Munson Meadow (6230 ft., CLNP 406), and from a small pond along Wheeler Creek (5570 ft., CLNP 430). This species is extremely abundant at Diamond Lake, a few miles north of the Park.

HYLA REGILLA Baird and Girard—Pacific Tree Frog

Hyla regilla, Campbell (1934:1), Fitch (1936:40), Vincent (1947a:20), Funkhouser (1949:13).

The Pacific tree frog is fairly common throughout the Park up to elevations of about 7000 feet. They may be heard at Park Headquarters (6476 ft.) as early as the first week in July when there is still much snow on the ground. We have specimens from Rim Village (7100 ft., CLNP 9), Munson Meadow (6300 ft., CLNP 342), between Annie Creek and Sun Creek (4750 ft., CLNP 271), Annie Creek, (4500 ft., CLNP 460), Crater Spring (5350 ft., CLNP 396), Boundary Springs (5350 ft., CLNP 395), a pond southeast of Arant Point (6250 ft., CLNP 474), and the shore of the lake beneath Hillman Peak (6160 ft., CLNP 457). At the last locality many larvae were observed in metamorphosis on September 1, 1951; they were associated there with *Bufo boreas*. We have observed *regilla* also at Park Headquarters, in Copeland Creek canyon and in the beaver ponds on Copeland Creek. Larvae may be found in considerable abundance in the ponds in Munson Meadow. Campbell (1934:1) recorded it from Twin Springs and Vincent (1947:20) observed it at Red Cone and on Wizard Island. In the vicinity of the Park we have found it to be common at Diamond Lake, Spruce Lake and Lake West.

RANA CASCADAE Slater—Cascade Frog

Rana aurora, Evermann (1897:235). *Rana aurora aurora*, Storer (1925:230); Gordon (1939:61). *Rana pretiosa pretiosa*, Campbell (1934:2); Fitch (1936:641); Gordon (1939:64). *Rana pretiosa*, Slevin (1938:136); Pickwell (1947:20). *Rana*

cascadii [sic], Vincent (1947a:20). *Rana boylli boyllii*, Vincent (1947a:20; 1947b:22). *Rana cascadae*, Funkhouser (1949:12); Dunlop and Storm (1951:81).

This species is extremely abundant along all of the water courses and spring areas in the Park. It also occurs along the shore of the lake. It was first observed, apparently, by Evermann (1897) in 1896; a specimen was taken from the lake and several were seen at the spring near the camp of his party. Since that time its abundance has been noted by all who have written about the amphibians of the Park.

We have adult specimens from Castle Crest (6400 ft., CLNP 324), Munson Meadow (6300 ft., CLNP 341), Annie Creek (4500 ft., 350), East Fork, Annie Creek (6300 ft., CLNP 337), Sun Meadow (6800 ft., CLNP 347), Red Blanket Creek (5600 ft., CLNP 333, 487), Castle Creek (6100 ft., CLNP 324), Bybee Creek (6863 ft., CLNP 340), Copeland Creek (5000 ft., CLNP 26), Crater Spring (5350 ft., CLNP 391), National Creek (5290 ft., CLNP 397), Boundary Springs (5350 ft., CLNP 393), Sand Creek Canyon (5250 ft., CLNP 28), Wheeler Creek Canyon (5850 ft., CLNP 25) and Maklaks Spring (5450 ft., CLNP 349). There are specimens of larvae and/or recently metamorphosed individuals from Munson Meadow (6300 ft., CLNP 73, 405) and Copeland Creek (5400 ft., CLNP 348).

Although our information on the life history of this species is somewhat fragmentary, it may nevertheless be of some interest. Larvae may be found in pools varying greatly in depth, surface area, temperature, and amount of cover. They are found frequently in temporary pools. The eggs are deposited in June or early July. Sometimes, at least, they are deposited in water beneath snow. On July 1, 1948, a mass of gel containing embryos was collected from a pool in Munson Meadow that had been uncovered from snow less than seven days. The embryos had already attained a stage of development requiring substantially more than a week. On July 3, these embryos (3.7 mm. in length) were showing sporadic movements. Metamorphosis occurs during the first summer when body length is 20-25 mm. Individuals, which we interpret to be in their second summer, have a body length of 35-50 mm. The largest group, 65-80 mm., would appear to be in the third summer or older. The relative abundance of the smaller size group in comparison to the latter supports this supposition.

Although we have not studied the situation exhaustively, we believe the form in the Park approaches *cascadae* more closely than it approaches any of other closely related species. The specimens in our collections display a great deal of variation. In some the skin is smooth and in others extremely pustulose. The ground color varies from dark in some specimens to light in others. In all of our specimens the heel reaches the eye and sometimes slightly beyond the nostril. That this form has in the past been confused with *Rana aurora* and *Rana pretiosa* indicates a possibility of intergrading populations. Although we have compared our material with topotypes of *cascadae* we are not prepared to solve the relationships of these three forms. Slater (1939) in his description of *cascadae* states that it overlaps with *aurora* in the Hudsonian zone of the Cascades of Washington. We are unable to see any constant differences in our collections of the genus *Rana* in the Hudsonian and Canadian zones. Admittedly, however, differences could be obscured by

the extensive variability of our material. Dunlop and Storm (1951) have assigned specimens from Crater Lake to *cascadae*.

Vincent (1947b) reported *Rana boylei* Baird from the Park on the basis of a single specimen (CLNP 222), collected on July 2, 1947. This immature specimen, on which Vincent's record is based, is referable to *cascadae*. It seems probable that the misidentification resulted from the immaturity of the specimen. According to Fitch (1938a) *boylei* is common in suitable habitats in the Rogue River Basin and at Lake of the Woods (Klamath County). He has also collected it along the Klamath River north of the state boundary (Klamath County). Although it is therefore possible that this species may occur in the Park, there is as yet no positive evidence.

SCELOPORUS GRACIOSUS GRACILIS Baird and Girard—
Northern Mountain Lizard

Although lizards of the genus *Sceloporus* are abundant in the Klamath Valley and in the Rogue River basin (Fitch 1936:642) they are seen only infrequently in the Park. We have specimens from Wheeler Creek Canyon at the East Entrance (CLNP 41, 466) and Annie Creek one-fourth mile south of the South Boundary (CLNP 43). We have observed these lizards in the dry area along the east side of Annie Creek within the Park but have been unable to procure specimens. We have seen one along the Rim above the Palisades (6500 ft.).

PHRYNOSOMA DOUGLASSII DOUGLASSII (Bell)—Pigmy Horned Toad
Phrynosoma sp., Campbell (1934:2). *Phrynosoma douglassi douglassi* [sic], Vincent (1947a:22).

The occurrence of this species in Crater Lake National Park is problematical. Campbell (1934:2) states that he saw a specimen of a horned toad "which had been caught by the CCC boys of Wineglass Camp in the woods several miles down the motorway which leaves the Wineglass and goes toward the northern boundary." This would be at an elevation of 5500-5700 feet and in the arid ponderosa pine forest with sage and manzanita. Joseph S. Dixon (field notes) obtained a specimen (MVZ 40761) of a horned toad collected by James Tucker "on August 15, 1944, at 6000 feet on pumice desert 5 mi. N. of Crater Lake about half way between Grouse Hill and Timber Crater." Since this species is not uncommon in suitable habitats at lower elevations in Klamath County, its occurrence in the above-cited areas in the Park would not be unusual. On the other hand, it is necessary to remember that horned toads are frequently acquired and kept as pets; this must be considered with respect to the Crater Lake records. We have diligently searched for this species in the above-cited localities with no success.

ELGARIA COERULEA SHASTENSIS (Fitch)—Northern Alligator Lizard
Gerrhonotus sp., Campbell (1934:2). *Gerrhonotus coeruleus principis*, Fitch (1936:642); Gordon (1939:69); Vincent (1947a:21). *Gerrhonotus coeruleus shastensis*, Vincent (1947a:21).

The alligator lizard is rarely seen within the Park. Our total collection consists of three specimens from the following localities: Summit of Union Peak (7698 ft., CLNP 360); along Copeland Creek (5400 ft., CLNP 44) and the rock slide near Park Headquarters (6400 ft., CLNP 313). Fitch (1936:642) also reports a single specimen taken within the Park. Our

specimens are actually intermediate between *principis* and *shastensis* but have been assigned to the latter subspecies because of the predominance of *shastensis* characters.

THAMNOPHIS SIRTALIS FITCHI FOX—Northwestern Garter Snake

Thamnophis leptocephalus, Evermann (1897:235). *Thamnophis sirtalis infernalis*, Campbell (1934:2). *Thamnophis ordinoides*, Brode (1938:52). *Thamnophis sirtalis* ssp., Vincent (1947a:21).

This snake is fairly common in suitable localities in the Park. We have observed it most frequently along the lakeshore, on Wizard Island, along upper Copeland Creek and around a pond in a sphagnum bog south of Crater Creek Motorway Spur. Its presence has also been noted in some of these localities by Campbell (1934:2) and Vincent (1947a:21). We have specimens from Wizard Island (CLNP 46, 47, 48, 57, 59), Copeland Creek (CLNP 45), Eagle Cove (CLNP 465) and Red Blanket Creek (5550 ft., CLNP 470). The population along the lakeshore and on Wizard Island is of interest because of considerable numbers of slate-gray individuals with no markings whatsoever (CLNP 48, for example). It is possible that the conformance of this color with the color of the rocks in the environment may be of selective value.

ACKNOWLEDGEMENTS

We are indebted initially to Doctor George C. Ruhle, Park Naturalist, Crater Lake National Park, who first suggested this investigation and then included it as a part of the naturalist program. The major portions of the investigations were accomplished while the authors were members of the temporary naturalist staff, Crater Lake National Park. Superintendent E. P. Leavitt has continually recognized the value and necessity of investigations of the flora and fauna of the Park as well as the importance of the preservation of the collections of specimens. We are indebted to Lawrence Bisbee, Fred Larmie, Philip Ross, E. J. Bucknall, Roy Strand, D. J. Illige, Dr. John W. Funkhouser, Dr. Donald C. Lowrie, Melvin Erickson, Armour Winslow, and Richard Lash for invaluable assistance in the field. Chief Ranger Louis W. Hallock and Rangers Wayne R. Howe, G. Lee Sneddon, and Paul Turner have helped us in many ways. Dr. Robert C. Stebbins has kindly identified our specimen of *Ensatina eschscholtzii oregonensis* (Girard). Dr. E. H. Taylor has painstakingly examined our several hundred specimens of amphibians and has read the entire manuscript; his suggestions have been invaluable. The reptiles have been identified by Dr. Henry S. Fitch who has carefully examined the entire manuscript and has also made important suggestions. We are greatly indebted to Mr. Clifford H. Pope who read the manuscript critically, made corrections and provided us with valuable suggestions. Dr. Doris M. Cochran has generously supplied information concerning specimens in the U. S. National Museum. Further we are indebted to Dr. Marion Ownbey for suggestions with respect to botanical nomenclature. Although the kind assistance of those cited above has been indispensable, final decisions in all matters have been made by us and we consequently assume full responsibility for them.

REFERENCES

- ANDERSON, OSCAR I. AND JAMES R. SLATER 1941—Life zone distribution of Oregon reptiles. Occasional Papers, Department of Biology, College of Puget Sound 12:15:109-119.
- ANONYMOUS 1928—Food for fish. Crater Lake National Park Nature Notes 1(2):11.
- ARNOLD, J. R. AND W. F. LIBBY 1951—Radiocarbon dates. Science 113:111-120.
- BISHOP, SHERMAN C. 1941—Notes on salamanders with descriptions of several new forms. Occasional Papers, Museum of Zoology, University of Michigan 451:22 pp.
- 1943—Handbook of salamanders. Comstock Publishing Company:xiv+555 pp.
- BRODE, J. STANLEY 1935—Food habits of Crater Lake fish. Crater Lake National Park Nature Notes 8(3):11-13.

- 1938—Denizens of Crater Lake. Northwest Science 12(3):50-57.
- CAMPBELL, BERRY 1929—Notes on three amphibians. Crater Lake National Park Nature Notes 2(2):8.
- 1934—Annotated list of the vertebrates of Crater Lake. Mimeographed, 22 pp.
- COUNT, EARL W. 1932—Wizard Island. Crater Lake National Park Nature Notes 5(2):4-5.
- DUNLOP, D. G. AND R. M. STORM 1951—The Cascade Frog in Oregon. Copeia 1951(1):81.
- EVERMANN, B. W. 1897—U. S. Fish Commission investigation at Crater Lake. Mazama 1(2):230-238.
- FARNER, DONALD S. 1946—Food habits of Crater Lake salamanders. Crater Lake National Park Nature Notes 12:27-28.
- 1947—Notes on the food habits of the salamanders of Crater Lake, Oregon. Copeia 1947:259-261.
- FITCH, H. S. 1936—Amphibians and reptiles of the Rogue River basin, Oregon. Amer. Midl. Nat. 17(3):634-652.
- 1938a—*Rana boylei* in Oregon. Copeia 1938(3):148.
- 1938b—An older name for *Triturus similans* Twitty. Ibid. 1938(3):148-149.
- 1935—Natural history of the alligator lizards. Transactions of the Academy of Science of St. Louis 29:1-38.
- FUNKHOUSER, JOHN W. 1949—Adventures with park amphibia. Crater Lake National Park Nature Notes 15:12-13.
- GORDON, KENNETH 1931—The amphibia and reptilia of Oregon. Oregon State Monographic Studies in Zoology 1:1-82.
- HASLER, ARTHUR D. 1938—Fish biology and limnology of Crater Lake. Journal of Wildlife Management 2(3):94-103.
- AND D. S. FARNER 1942—Fisheries investigations in Crater Lake, Oregon, 1937-1940. Ibid. 6(4):319-327.
- HEATH, JAMES P. 1938—Collection of amphibia at Crater Lake National Park. Manuscript in files of Park Naturalist, Crater Lake National Park.
- HUBBARD, C. ANDRESEN 1933—Fact and fancy about Crater Lake fish. Ibid.
- MITTLEMAN, M. B. 1948—American caudata. II. Geographic variation in *Ambystoma macrodactylum*. Herpetologica 4(3):81-95.
- AND G. S. MYERS 1949—Geographic variation in the Ribbed Frog, *Ascaphus truei*. Proceedings of the Biological Society of Washington 62:57-68.
- MYERS, G. S. 1942—Notes on Pacific Coast *Triturus*. Copeia 1942(2):77-82.
- PICKWELL, GAYLE 1947—Amphibians and reptiles of the Pacific states. Stanford University Press:xx+238 pp.
- SLATER, JAMES R. 1936—Notes on *Ambystoma gracile* Baird and *Ambystoma macrodactylum* Baird. Copeia. 1936(4):234-236.
- 1939—Description and life-history of a new *Rana* from Washington. Herpetologica 1(6):145-149.
- SLEVIN, J. R. 1928—The amphibians of Western North America. Occasional Papers of the California Academy of Science 16:152 pp.
- STEBBINS, ROBERT C. 1949—Speciation in salamanders of the plethodontid genus *Ensatina*. University of California Publications in Zoology 48(6):377-526.
- STORER, TRACY I. 1925—A synopsis of the amphibia of California. Ibid. 27. 308 pp.
- TWITTY, C. V. 1942—The species of California *Triturus*. Copeia 1942(2):65-76.
- UTTERBACK, CLINTON L., LYMAN D. PHIFER AND REX J. ROBINSON 1942—Some chemical, planktonic and optical characteristics of Crater Lake. Ecology 23(1):97-103.
- VINAL, WM. G. 1933—Wizard Island: its succession of life. Crater Lake National Park Nature Notes 6(4):2-5.
- VINCENT, W. S. 1947a—A checklist of amphibians and reptiles of Crater Lake National Park. Ibid. 13:19-22.
- 1947b—First record of the Californian yellow-legged frog found in park. Ibid. 13:22.
- WALLIS, O. L. 1947—The 1947 catch in Crater Lake. Ibid. 13:17-19.
- WILLIAMS, HOWEL 1942—The geology of Crater Lake National Park, Oregon. Carnegie Institution of Washington Publication 540: 162 pp.

Preliminary Notes on the Ecology of Freshwater Algae in the Arctic Slope, Alaska, with Descriptions of Some New Species

G. W. Prescott*

Michigan State College, East Lansing

Whereas a few reports have been published on freshwater algae of eastern Arctic America (e.g., Cedercreutz, 1944; Dickie, 1880; Dutilly & Lepage, 1946; Gardner, 1949; Jennings, 1936; Lowe, 1923; Whelden, 1947) we have practically no knowledge of the flora in northern Alaska. Saunders (1901) has made a helpful contribution to a knowledge of Alaskan algae, but his report is based on collections below the Arctic Circle. Most of our information on these plants in the Arctic has come from the surveys made in Greenland, Lapland, and northern Russia (e.g., Boergesen, 1896, 1901, 1917; Bohlin, 1893; Boldt, 1885, 1893; Borge, 1891, 1892, 1894; Grönblad, 1924; Kossinskaja, 1936; Krieger, 1938; Lagerheim, 1883, 1884, 1884-a, 1894, 1900, Larsen, 1907; Nordstedt, 1872, 1875, 1885; Voronikhin, 1930; Wille, 1879, 1880; Wittrock, 1872, 1883, and many others). A survey of western Arctic algae is highly desirable, therefore, from both a taxonomic and an ecological point of view. We need to determine the circumpolar distribution of species and also to determine the extent to which temperate zone algae are distributed in the Arctic.

The Arctic slope in northern Alaska is a supposedly unglaciated, nearly flat tundra, sloping gently from the Brooks Range to the Arctic Ocean, lying within 67° - 71° $21'$ N. Lat. Throughout this plain are innumerable lakes, the larger ones of which are curiously oriented northwest-southeast. The lakes vary in size from ponds a few acres in area to bodies of water 5 to 20 miles or more in length. Between the lakes occur hundreds of thousands of small ponds and swales, and between these are pools, seeps, and ditches so that in many sections there is more water than land surface (71° - 71° $10'$ N. Lat., 156° $20'$ - 156° $40'$ W. Long., e.g.).

Environmental conditions would seem to be somewhat uniform throughout much of this monotonous expanse, and whereas a corresponding similarity might be expected to exist in the algal flora of the lakes, such has not been found to be the case. The Arctic Research Laboratory with its facilities for both outdoor and indoor operations is being used as a base for a survey of the algal flora of the Arctic slope. In following out the taxonomic objectives of this investigation analyses are being made of the pertinent limnological factors to determine what correlated conditions exist which might explain the variability in the flora of closely situated lakes. A year-around investigation

* This study was carried on under a contract with the Office of Naval Research. Contents of this paper have been cleared for publication. The author wishes to express appreciation to the Arctic Research Laboratory at Point Barrow and to the Office of Naval Research for providing the facilities which have made possible a survey of the algae in Petroleum Reserve No. 4.

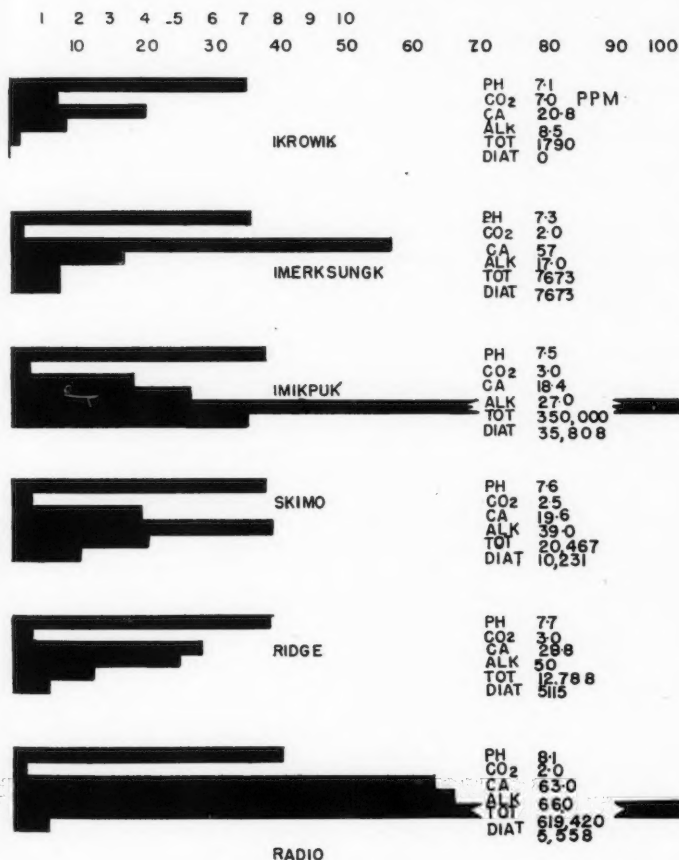
is now in progress (1952-1953) whereas in 1951 only late summer collections were made. After a preliminary reconnaissance several lakes were chosen for making a comparative study, and accordingly bi-weekly collections of algae (quantitative and qualitative) and limnological samples were taken in the summer of 1951. During 1952 the same sequence of collections was made but extended to include late spring and midwinter periods.

The pH of practically all of the larger lakes in the Barrow region (2 to 3 M. in depth) is found to be on the basic side of neutrality (Ikrowik Lake, pH 7.0-7.1, which in the summer showed a pH of 6.8; Imerksungk Lake, pH 7.3; Imikpuk Lake, pH 7.5; Radio Pond, pH 8.1; see chart). But whereas many small ponds and tundra pools are found to have the same pH conditions as the larger lakes the majority of these are below neutral, some being as low as pH 5.3. The tundra pools which have a pH lower than neutral in almost every instance are those which are characterized by an aquatic plant association that includes *Hippurus vulgaris*, *Ranunculus Pallasii* and, being shallow, are frequently overgrown with *Arctophila fulva*. Not infrequently these acid water ponds are surrounded or nearly so by *Sphagnum* spp. Whatever the significance may be, it is to be noted that *Arctophila fulva* expresses itself in a gray-green strain when it grows in acid or slightly basic ponds, rather than being rusty red as it normally is or when growing in basic situations. This was found to be such a consistent relationship that the gray-green strain of the grass was used to locate ponds which had a predominantly chlorophycean-desmid flora, the red-colored grass occurring in association with a cyanophycean-diatom flora. Although *Nostoc commune* is of wide distribution and occurs in almost any aquatic habitat as well as upon the moist tundra mat, this species occurs in great abundance in swales overgrown with the red form of *Arctophila fulva*.

A type of desmid habitat with a low pH is the tundra ditch formed naturally between polygon ridges, or in the old tracks left by mobile units. In the latter, which are 2 or 3 years old, water has leached the broken and crumbled tundra and has accumulated enough nutrients and acids from the exposed soil to become a rather unique and relatively rich algal habitat. The water is dark with humic acids and the bottom is a layer of rusty-colored colloidal matter and organic debris. Associated with desmids in such a habitat is a dense growth of motile algae which ordinarily are found in water relatively well-supplied with nutrients such as phosphorus and nitrogen. *Chlamydomonas* spp., *Pandorina morum*, *Chroomonas* spp., *Dinobryon* spp. and *Euglena* spp. are invariably present in large numbers, together with a profuse zoogloea of bacteria and fungi which form balloon-like masses over the ends of submerged grass leaves and moss stems. Likewise ditches, in which water has seeped from the tundra crumbled by ice and frost action, often support a desmid flora and have a pH which may be as low as pH 5.3.

A conspicuous element of the terrestrial algal flora in habitats that are rich in nitrogen (skeletons of animals, including human skeletons) is *Prasiola crispa*. This species is often associated in aquatic habitats with *Monostroma amorphum*.

The midsummer water temperatures, which are regarded as being of little or no significance, are about 5° C. The O₂ content is correspondingly high,



Quantitative counts of organisms per liter in six representative lakes in the Point Barrow region in relation to pH and alkalinity. (The total number of organisms per L. in Imikpuk Lake and Radio Pond are not completely expressed by the horizontal bars.)

Numbers 1-10 indicate: pH; CO₂ ppm. in units of 5; total number of organisms per L. in units of 5000; Diatoms per L. in units of 5000. Numbers 10-100 indicate: Calcium ppm.; Methyl Orange Alkalinity ppm.

being as much as 12 ppm. The CO_2 on the other hand is relatively low (see chart), most lakes having only 2 ppm. or 3 ppm. In correlation with the pH of various lakes, Methyl Orange alkalinity was found to vary considerably (Ikrowik Lake, 8.5 ppm.; 66 ppm. in Radio Pond which has a pH of 8.1). The latter lake had the greatest phytoplankton productivity of any investigated (619,420 organisms per L.). This relationship between the amount of M. O. alkalinity and plankton production is in almost direct proportion also in other lakes studied. This is to be expected inasmuch as high alkalinity nearly always is correlated with an abundance of bicarbonates from which photosynthetic organisms may draw CO_2 , thus making possible a more profuse growth. Lakes with a normally low CO_2 content and a low M. O. alkalinity are correspondingly poor producers (Ikrowik, Imerksung Lakes). A low calcium content, however, is not always correlated with low M. O. alkalinity, as in Imerksung Lake, for example, which has a calcium reading of 57.0 ppm. at a time when the M. O. alkalinity was 17.0 ppm.

To determine phytoplankton productivity, counts were made from several selected lakes. The average midsummer counts, both total and for numbers of diatoms, are plotted on the accompanying chart. Subsequent chemical analyses should provide an explanation for the quantitative difference in the lakes under investigation.

The high degree of variation in the quality of the flora in respective lakes is as yet unexplainable, although intriguing. Skimo Lake, lying about one-half mile southwest from Barrow village, for example, has a profuse development of *Pediastrum* spp. (*P. Boryanum*, *P. duplex*, *P. simplex*) which on some days reached practically 'bloom' proportions. It is unusual for this genus to occur in such quantities as to color the water. Other lakes lying in the immediate vicinity show no or scarcely any *Pediastrum*, thus suggesting the presence of a particular set of determiners conducive to the development of these species in Skimo Lake.

Imikpuk Lake, near Point Barrow Base, presented a veritable 'bloom' of *Uroglenopsis americana* in midsummer tow samples, but the organism was not found in other lakes in the Barrow region. Also in this lake are 2 species of *Vaucheria* which together form a mat over most all portions of the bottom, apparently, where water is deep enough to provide protection from wave action. This too appears to be a unique situation for no other lake investigated had such a blanket, although *Vaucheria* is common enough over the tundra in seeps and in other subaerial habitats. The bulky vegetation in Imikpuk Lake obviously plays an important role in the productivity of animal life and illustrates an element of the biota which cannot be measured in ordinary routine limnological examinations relating to productivity factors.

In Radio Pond (about 100 feet in diameter) lying 2 miles west of Point Barrow Base, the extraordinary plankton count of 619,420 organisms per L. (see Chart) is accompanied by a high pH (pH 8.1) and by an abundance of electrolytes, the M. O. alkalinity being as much as 66 ppm. The water was colored (unusual for Arctic ponds) mostly from *Ankistrodesmus convolutus* (611,304 cells per L.). As might be expected O_2 was abundant at the time this 'bloom' occurred (11.2 ppm.): CO_2 was 2.0 ppm. and iron 0.005 mg. per L. In general the larger lakes are relatively barren of phytoplankton

while at the same time they support a profuse faunal population of microcrustacea (*Daphnia*, *Eubranchipus*). Diatoms seem to be the chief contributors in the food chain within such lakes.

Pools in the tundra lying but a few feet apart often show marked variations in their algal flora composition. Euglenoids (*Trachelomonas* spp., *Phacus* spp., *Euglena* spp.) frequently occur in sufficient numbers to color the water here and there within a pool, whereas a neighboring one is practically sterile.

The well-known variations between one body of water and another in respect to the biota are thus magnified here where all the obvious growth-determining factors are apparently identical. One is tempted to resort to the speculation that growth-inhibiting and growth-producing substances liberated by organisms themselves account for the variations in the quality of the flora. In any case, it is obvious that there is a particular combination of optimal physico-chemical factors, involving micro-climatic variables, which determine the differences in the flora of closely approximated ponds. It is hoped that subsequent analyses of the habitat may provide an answer to this question.

Among the numerous algal species collected thus far, many of which are interesting because the range of distribution has been greatly extended for them, are some which are new to science.

Pseudendoclonium arctica sp. nov.*

Thallus massa irregularis mucilginis solidi fila brevia, torta, dissociata, radiatim ordinata includentis, cellulae fili subcylindricae polygonalesve, saepe non se contingentes, fila dichotome sed irregulariter ramosa cellulis terminalibus in apicem ontusum olerumque subatenuatis; zoosporae (?) quattuor in cellula globosa lateraliter in filo producta formata, aut ut segmentum cellulae singularis abscisae; chloroplasti 1, 2 vel 4, parietales, lamini-formes, omnibus pyrenoideum habentibus (?); cellulae 4.5-6.5 μ diam., 4.6-10.5 μ long. P. III.

Thallus an irregularly shaped mass of firm mucilage inclosing radiately arranged, dissociated, crooked short strands of subcylindrical or polygonal cells, the cells within individual series frequently not in contact, the strands branching dichotomously but irregularly, the terminal cells usually tapering slightly to a blunt apex; zoospores (?) formed 4 in a globular cell borne laterally on a strand, or cut off as a segment of a solitary cell; chloroplasts 1, 2 or 4 parietal plates with a pyrenoid in each (?); cells 4.6-6.5 μ in diam., 4.6-10.5 μ long. Pl. III.

Floating lumps of mucilage 3-4 cm. in diameter in a small, shallow tundra pond, 3 miles south of Point Barrow Base, Alaska. Ba. 133 (Holotype). Author's herbarium.

The thallus has the appearance and texture of *Aphanothece stagnina*, but the color of a *Tetraspora*. The arrangement of the short filaments is definitely radiate but the individual strands are irregular, usually consisting of not more than 4 or 5 cells. The plant could not be cultured in order to determine characteristics and reproductive habits. The common occurrence of cells with the protoplast divided into 4 spore-like bodies, however, suggested zoospore-formation. Within the mucilage many germinating spores and sporlings were found (Pl. III, Figs. 2-10) which had a *Stigeoclonium*-like appearance. The plant seems to have enough *Pseudendoclonium* characteristics to warrant the assignment to that genus, but the habit of growth and the type of thallus might necessitate designating it as a new genus. *P. submarinum* Wille is marine, but *P. basiliense* Vischer (1926) has been described from freshwater and its variety *Brandii* Vischer (1933) has been cultured from soil (Fritsch & John, 1942).

P. arctica differs from other species in the genus by the gelatinous matrix which incloses radiately arranged, short, branched filaments. Thus the thallus is a complex of

* The author is indebted to Dr. Hannah Croasdale for her assistance in preparing the Latin diagnoses.

numerous, scattered individual plants, each composed of but a few cells, these showing the same irregularity of arrangement characteristic of *Pseudoclonium*. The chloroplast (a parietal plate) is Chaetophoraceous and similar to that of *P. submarinum* Wille.

Vaucheria crenulata sp. nov.

Sec. CORNICULATAE; Subsect. RACEMOSAE

Filamenta ubique symmetrice undulata, massas implicatas fluitantes formantia, ramos multos rhizoides sine colore ferentia; gametangia pedicellata in ramis lateralibus brevibus, ex antheridio unico terminali atque oogonio uno constantia; oogonium late ovatum aut subsphaericale, membrana oogonii maturi longitudinaliter striata, praecipue prope porum, aut reticulo grosso incrassationum praedita, poro paululum deorsum verso; antheridium valde circinatum; oospora oogonium omnino complens, eadem forma, membranam lacunatam costatamque habens; filamenta vegetativa 36-39 μ diam., oogonium 94 μ diam., 94.101 μ long.; oospora 83 μ diam., 94 μ long.; antheridium 18.4 μ diam. Pl. II.

Filaments forming tangled, floating clots, symmetrically undulate throughout, bearing numerous colorless rhizoidal branches; gametangia pedicellate on short lateral branches, with one terminal antheridium and a single oogonium; the oogonium broadly oval or subspherical, when mature the wall longitudinally striate, especially near the pore, or with a coarse reticulum of thickenings, the pore directed slightly downward; antheridium strongly circinate; oospore the same shape as and quite filling the oogonium, the wall pitted and ridged; vegetative filaments 36-39 μ in diameter; oogonium 94 μ in diameter, 94.101 μ long; oospore 83 μ in diameter, 94 μ long; antheridium 18.4 μ in diameter. Pl. II.

Attached, but forming floating clots in Imikpuk (Freshwater) Lake, Barrow Base. Ba. 193 (Holotype); Ba. 313-315 (G. W. Prescott Herbarium). Occurring with *V. sessilis* on bottom of lake.

Vaucheria crenulata differs from other closely related species by the undulate filaments and by the pitted oospore wall. The latter character shows on mature spores, especially if plasmolyzed.

Vaucheria pseudohamata sp. nov.

Sec. CORNICULATAE; Subsect. RACEMOSAE

Filamenta tegetem implectam affixam formantia, membranis saepe crassis lamellatisque, saepe septata, aplanosporas globosas ovatasve formantia; filamenta vegetativa atque aplanosporae guttis olei intus conferte impleta; oogonia antheridiaque in ramis lateralibus brevibus producta; oogonium singulare terminaleque, ovatum globosumve, pore horizontaliter aut paululum deorsum verso, per antheridia 1, 2, vel 3, valde circinata, per septationem rami gametangialis a se interdum seiuncta, subtensum; oospora oogonium omnino complens, eadem forma, membranam plerumque crassam, lacunatam, scrobiculatam aut cum nonnullis scrobiculationibus rugosa, habens; filamentum vegetativum (44)-59-69 μ diam., ramus gametangialis 57.5 μ diam.; oogonium 81-92 μ diam., 115-119 μ long.; oospora 90-92 μ diam.; antheridium 23-29 μ diam. Pl. I.

Filaments forming a tangled, attached mat, the walls often thick and lamellate, frequently septate, forming aplanospores intercalary which are subcylindrical, or globular or oval aplanospores at the ends of branches; contents of vegetative filaments and aplanospores densely packed with oil bodies; oogonia and antheridia borne on short lateral branches, the oogonium solitary and terminal, oval or globose, with the pore turned horizontally or slightly downward, subtended by 1, 2, or 3 strongly circinate antheridia which may be separated from one another by septations of the gametangial branch; oospore the same shape as and quite filling the oogonium, the wall generally thick, pitted and scrobiculate or rugose with some scrobiculations; vegetative filaments (44)-59-69 μ in diameter; gametangial branch 57.5 μ in diameter; oogonium 81-92 μ in diameter, 115-119 μ long; oospore 90-92 μ in diameter; antheridium 23-29 μ in diameter. Pl. I.

Forming a mat in a trickle of water through a gully in the tundra near the sea, about 1 mile west of Barrow village. Ba. 24. (Holotype); Ba. 268. Author's herbarium.

This species should be compared with *V. terrestris* (Vauch.) DeCandolle var. *scrobiculata* (Magn. & Wille) Brown (1929). The Alaskan plant differs in having a smaller size, more irregular thickenings on the oospore membrane, and in the arrangement of the antheridia. In *V. terrestris* there is but a single antheridium on a gametangial branch.

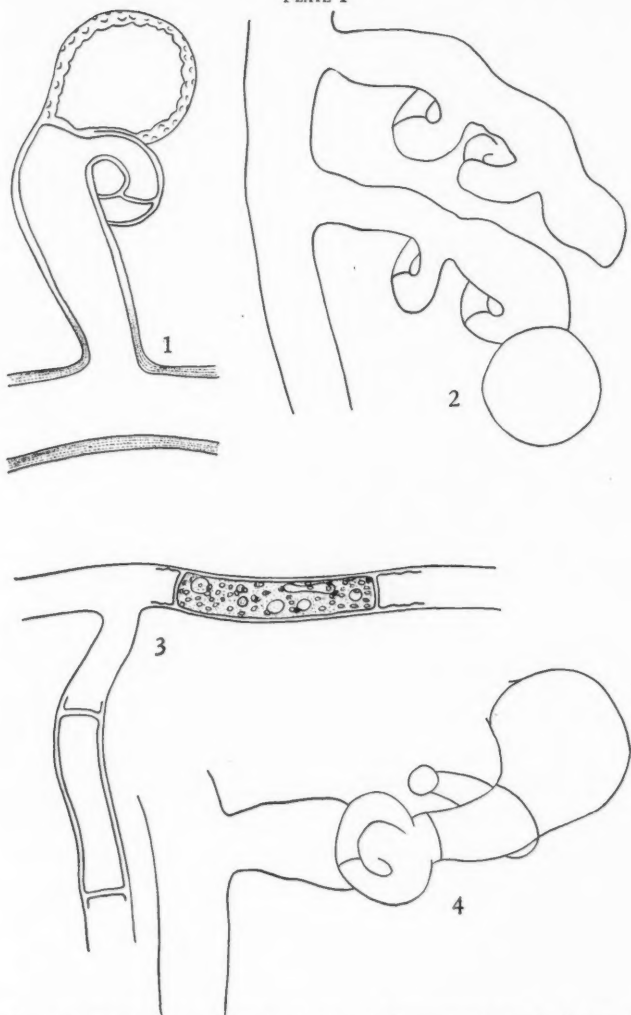
Especially in the markings on the oospore wall *V. pseudohamata* differs from *V. hamata* (Vauch.) DeCandolle. (Goetz. 1897; Walz, 1866).

REFERENCES

- BOERGESEN, F. 1896—Ferskvandsalger fra Östgrönland. Medd om Groenland (1894) 18:1-41. Pls. 1, 2. (Publ. 1896).
- 1901—Freshwater algae of the Faeröes. Botany of the Faeröes, Part I:198-259. Pls. 7-10. Copenhagen.
- 1917—Freshwater algae from the "Danmark-Expedition" to N. E. Greenland (N of 76 N. Lat.). Danmarks Expedition til Grönlands Nordøstkyst 1906-1908. Medd. om Grönland 43(3):69-90.
- BOHLIN, K. 1893—Snöalger från Pite Lappmark. Bot. Notiser 1893 (43):42-46.
- BOLDT, R. 1885—Bidrag till Kännedomen om Sibiriens Chlorophyllophyceer. Oef. af K. Sven. Vet. Akad. Förhandl. 42(2):91-128.
- 1888—Desmidiæer från Grönland. Bihang t. K. Svensk. Vet. Akad. Handl. Ser. 3, 13(III), 5:1-48. Pls. 1, 2.
- 1893—Nagra sötvattens-alger från Grönland. Bot. Notiser 1893 (43):156-158.
- BORGE, O. 1891—Ett litet bidrag till Siberiens Chlorophyllophyce-flora. Bihang t. K. Sv. Vet. Akad. Handl. XVII, (III), 2:1-15. 1 Pl.
- 1892—Chlorophyllophyceer från norska Finnmarken. Ibid. XVII, (III), 4:1-15. 1 Pl.
- 1894—Süsswasserchlorophycéen gesammelt von Dr. A. O. Kihlmann im nördlichen Russland, Gouvernement Archangel. Ibid. XIX, (III), 5:1-41. 3 Pls.
- BROWN, HELEN J. 1929—The algal family Vaucheriaceae. Trans. Amer. Microsc. Soc. 48(1):86-117. Pls. 15-20.
- CEDERCREUTZ, C. 1944—Freshwater algae from Labrador. Soc. Fauna et Flora Fenn. Memor. 19:216-222.
- DICKIE, G. 1880—On the algae found during the Arctic Expedition. Jour. Linn. Soc. Bot. 17:6-12.
- DUTILLY, A. AND E. LEPAGE 1946—Coup d'oeil sur la flore subarctique du Québec, de la Baie James au Lac Mistassini. Le Nat. Canad. 73:419-435.
- FRITSCH, F. E. AND R. P. JOHN 1942—An ecological and taxonomic study of the algae of British soils. II. Consideration of the species observed. Ann. Bot. 6(23):371-395. Figs. 1-8.
- GARDNER, G. 1949—Algues, Lichens, Mousses, Hepatiques récoltées au Labrador a la Baie d'Hudson, a la baie James et dans le Manitoba-Nord en 1930, 1933, 1937, 1938 et 1939. Mém. Soc. Bot. France 1949:74-94.
- GOETZ, H. 1897—Zur Systematik der Gattung *Vaucheria* D. C. Flora 83:88-143. Figs. 1-55.
- GRÖNBLAD, R. 1924—Einige Desmidiaceen aus Sibirien. oc. Sci. Fenn. Comm. Biol. 1(8):1-9. 6 figs.
- JENNINGS, O. E. 1936—Algae and fungi of Southampton Island. Article 1. The Exploration of Southampton Island. Mem. Carnegie Mus., Pittsburgh 12, 3(1):1-3.
- KOL, ERZEBET 1942—The snow and ice algae of Alaska. Smithson. Misc. Coll. 10(16):1-36. 6 Pls. Map.
- KOSSINSKAJA, C. 1936—Desmidiæen des Arktis. Acta Inst. Bot. Acad. Sci. USSR 3:401-450. 5 Pls.
- KRIEGER, W. 1938—Süsswasseralgen aus Spitzbergen. Ber. d. Deutsch. Bot. Ges. 56:55-72.
- LAGERHEIM, G. 1883—Bidrag till Kännedomen om Snöfloran i Lulea Lappmark. Bot. Notiser 1883:230-235.
- 1884—Ein Beitrag zur Schneeflora-Spitzbergens. La Nuova Notar. 1894:650-654.
- 1884a—Algologiska och mykologiska anteckningar från en botanisk resa i Lulea Lappmark.
- 1894—Studien über arktische Cryptogamen. Tromsö Mus. Aarsh. 1894:1-24. (reprint).
- 1900—Beiträge zur Flora der Bären-Insel. 2. Vegetabilisches Süsswasser-Plankton aus der Bären-Insel. Bihang t. K. Sv. Vet. Akad. Handl. XXVI, (III), 11:1-25.
- LARSEN, E. 1907—Ferskvandsalger fra Vest-Grönland. Medd. om Grönland 33(8):307-364. 2 Pls.

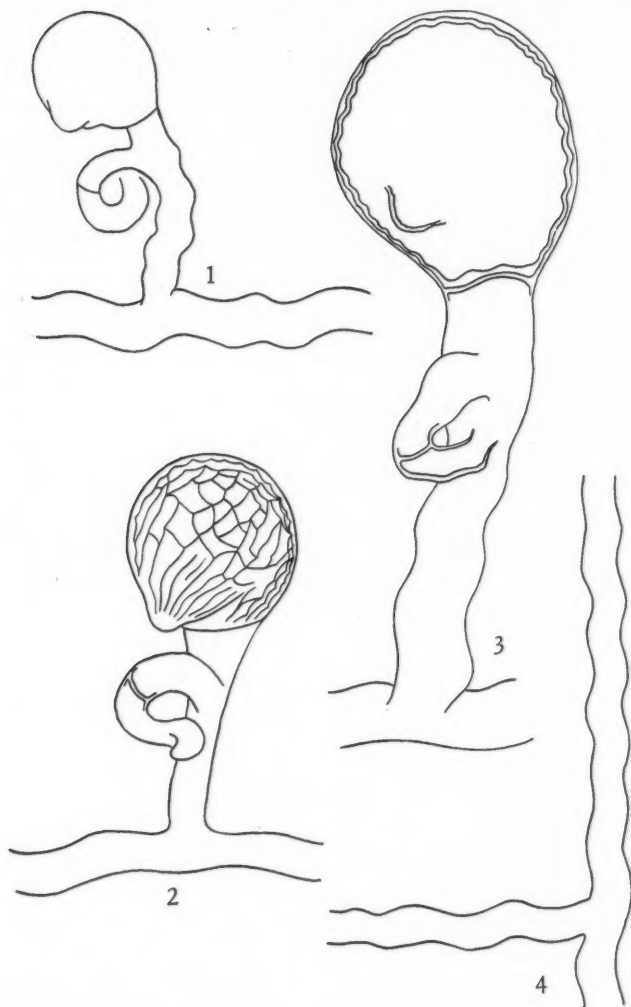
- LEY, SHANG-HAO 1944—The *Vaucheriaceae* from northern Kwantung, China. *Sinensia* 15(1/6):91-96. Figs. 1a-1g.
- LOWE, C. W. 1923—Report of the Canadian Arctic Expedition 1913-1918. Vol. 4. Botany, Part A. Freshwater algae and freshwater diatoms. Southern Party 1916-1916 4:3a-53a.
- NORSTED, C. F. O. 1872—*Desmidiaceae ex insulis Spetsbergensibus et Beeren Eiland*. Oefv. af K. Sven. Vet. Akad. Förhandl. 1872, No. 29:23-41.
- 1875—*Desmidiaceae Arctoae*. Ibid. 1875, No. 6:13-42. 3 Pls.
- 1885—*Desmidieer samlade af S. Berggren under Nordenskiöld'ska Expedition till Groenland*, 1870. Ibid. 1885, 42, No. 3:5-13.
- PRESCOTT, G. W. 1938—A new species and a new variety of the algal genus *Vaucheria*, with notes on the genus. *Trans. Amer. Microsc. Soc.* 57:1-10. 2 Pls.
- SAUNDERS, DE ALTON 1901—Papers from the Harriman Alaska Expedition. 25. The Algae. *Proc. Wash. Acad. Sci.* 3:391-486. Pls. 43-62.
- VISCHER, W. 1926—*Études algologie expérimentale*. *Bull. Soc. Bot. Genève* 18:184-245.
- 1933—Über einige kritische Gattungen und die Systematik der Chaetophorales. *Beih. Bot. Centralbl.* 51(1):2-100. 40 Figs.
- VORONIKHIN, N. N. 1930—The algae of the polar and northern Urals. *Trav. Soc. Nat. Leningrad* 60:3-80. 3 Pls.
- WALZ, J. 1866—Beitrag zur Morphologie und Systematik der Gattung *Vaucheria*. *Pringsh. Jahrb.* 5:127-160. Pls. 12-14.
- WHELDEN, R. M. 1947—Algae. In: Polunin, N. Botany of the Canadian Eastern Arctic. Part II. Thallophyta and Bryophyta. *Nat. Mus. Canad. Bull.* 97:13-137. 8 Pls.
- WILLE, N. 1879—*Ferskvandsalger fra Novaja Semlja*. Oefv. af K. Sven. Vet. Akad. Förhandl. 1879, No. 5:13-74.
- 1880—*Bidrag til Kundskaben om Norges Ferskvandsalger I*. *Christiania Vid. Selsk. Förh.* 1880, No. 11:1-72.
- WITTROCK, V. B. 1872—Om Gotlands och Ölands Sötvattensalger. *Bihang till K. Sven. Vet. Akad. Handl.* 1872, No. 1:1-72.
- 1883—Om snöns och isens flora, särskildt i de arkyiska trakterna. In: Norden-skiöld, A. E. *Studier och forsningar Stockholm 1883*:63-124. Pls. 3-7.

PLATE I



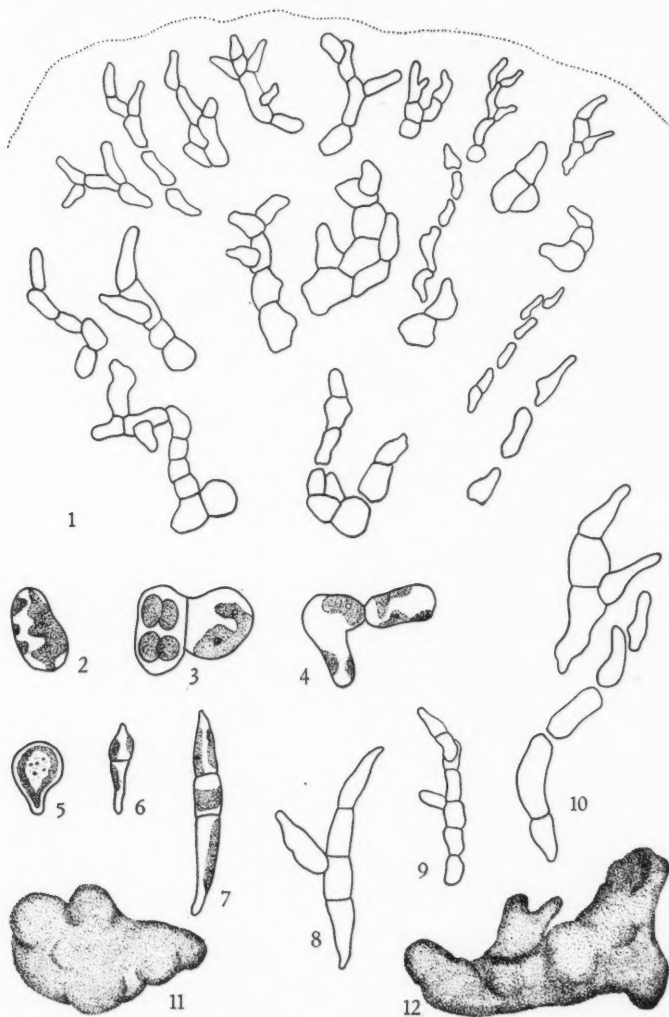
Figs. 1-4. *Vaucheria pseudohamata* sp. nov.—1. Gametangial branch, showing lamellate walls of the vegetative filament; oospore with scrobiculate walls. 2. Habit of gametangial branches with 2 antheridia. 3. Septations and beginning of aplanospore formation in the vegetative filaments. 4. Gametangial branch showing location of oogonium pore; the strongly recurved antheridia, the gametangial branch being septate between the two antheridia.

PLATE II



Figs. 1-4. *Vaucheria crenulata* sp. nov.—1. Habit of gametangial branch and the undulate form of the filaments. 2. Gametangial branch showing reticulate markings in the wall of the oogonium. 3. Oogonium with oospore. 4. A section of the vegetative filament showing regular undulations.

PLATE III



Figs. 1-12. *Pseudodoctonidium arctica* sp. nov.—1. Portion of thallus showing radiately arranged short filaments in the colonial mucilage. 2-10. Stages in the germination of spores to form short filaments: Fig. 3, zoospore (?) formation. 11-12. Habit of thallus $\times 1\frac{1}{2}$ life size.

The Production of Root Hairs by Aquatic Plants

Edfred Loren Shannon*

Cornell University, Ithaca, New York

The roots of aquatic plants have received relatively little attention. They are the least known, least understood, and least appreciated parts of aquatic plants. A vivid mental picture of an aquatic plant seldom includes the roots or root hairs. The frequently grossly inaccurate statements regarding the nature and extent of root hairs in aquatic plants have suggested the need of the present study—an intensive survey of the occurrence of root hairs on the roots of aquatic plants. A record of such factual data is a necessary preliminary step before it is possible to evaluate some of the opinions regarding the occurrence and functions of roots of aquatic plants.

According to Schenck (1886), Sachs (1887), Ludwig (1891), Noll (1902), Forel (1902), and Brown (1913), the principal function of the roots is to anchor aquatic plants to the substratum. On the other hand, Frank (1890), Sauvageau (1891), Hochreutiner (1896), Pond (1905), Snell (1908) and Bourn (1932) hold to the view that the roots of aquatic plants function in the absorption of water and nutrients much as terrestrial plants.

The supporters of the first view present no data on the occurrence of root hairs on aquatic plants. According to these authors, aquatic plants, being immersed and all parts being in contact with the water, do not "need to" increase their absorbing surface by root hairs. Accordingly, they maintain that root hairs are absent or rare in aquatic plants. In support of the hold-fast function of roots, it has been pointed out that the roots of some aquatics are modified for this purpose; e. g., twining or coiled roots are common in species of *Potamogeton*, *Zannichellia* and *Myriophyllum*, Arber (1920). Well developed root caps with a spreading base function in anchoring plants so as to prevent the dislodgment of floating-leaved plants by agitation of water by waves, e. g., *Brasenia schreberi*, Schrenk (1888).

The supporters of the view that roots function as organs of absorption have recorded only a few data on the occurrence of root hairs on aquatic plants. Some authors state that roots of aquatic plants do not produce root hairs unless they are growing in soil, Snell (1908), Cormack (1937), McDougall (1941), while others, Goebel (1891), state that some aquatic plants bear long root hairs but the roots do not enter the substratum.

Materials and methods. The present study is based largely upon observations on living plants of rooted vascular aquatic plants growing wild in New York State. This list of species was supplemented by the inclusion of several

* The writer is greatly indebted to Professor Walter C. Muenscher for invaluable assistance and helpful suggestions during the progress of this study.

introduced aquarium plants and a few native species from other sections of the United States. The data recorded on root hairs are based on microscopic studies and observations of living plants taken from the wild or plants grown in the aquarium tanks in the greenhouses of Cornell University. In every species at least several, and in most species many, individual plants from different localities were examined.

A total of 209 species representing 105 genera and 54 families was studied. Most of these species naturally grow rooted in mud, silt or sand on the bottom of shallow water. Many of these also produce roots in water but not in contact with the bottom. Roots growing in water as well as those growing in submerged substrata were examined for the presence of root hairs. In addition to the plants common in shallow water, several species were examined for each of the following habitats: submerged plants of deep lakes; plants of salt water and salt marshes; plants of tidal flats of the Hudson River; plants of acid sphagnum bogs.

The following table shows the results of observations made on the several species that produced root hairs as indicated by the numbers after them.

TYPHACEAE			
<i>Typha angustifolia</i> L.	2|3|4|5		
<i>Typha latifolia</i> L.	3|4|5		
SPARGANIACEAE			
<i>Sparganium americanum</i> Nutt.	2|		
<i>Sparganium angustifolium</i> Michx.	1a|		
<i>Sparganium chlorocarpum</i> Rydb.	1b|		
<i>Sparganium eurycarpum</i> Engelm.	2|		
<i>Sparganium multipedunculatum</i> (Morong) Rydb.	2|		
POTAMOGETONACEAE			
<i>Potamogeton alpinus</i> Balbis	1a|		
<i>Potamogeton nodosus</i> Poiret	1a|2|		
<i>Potamogeton amplifolius</i> Tuckerm.	1a|2|		
<i>Potamogeton illinoensis</i> Morong	1a|2|		
<i>Potamogeton bupleuroides</i> Fern.	1d|		
<i>Potamogeton confervoides</i> Reichenb.	2|		
<i>Potamogeton crispus</i> L.	1b|		
<i>Potamogeton ephedrus</i> Raf.	2|		
<i>Potamogeton filiformis</i> Pers.	1a|		
<i>Potamogeton foliosus</i> Raf.	2|		
<i>Potamogeton friesii</i> Rupr.	1a|		
<i>Potamogeton gramineus</i> L.	2|		
<i>Potamogeton latifolius</i> (Robbins) Morong	1b|		
<i>Potamogeton natans</i> L.	2|		
<i>Potamogeton oakesianus</i> Robbins.	2|		
<i>Potamogeton obtusifolius</i> Mert. & Koch.	2|		
<i>Potamogeton berchtoldii</i> Fieber.	1a|		
<i>Potamogeton pectinatus</i> L.	2|		
<i>Potamogeton praelongus</i> Wulfen.	1a|		
<i>Potamogeton pulcher</i> Tuckerm.	1b|		
<i>Potamogeton pusillus</i> L.	1a|		
<i>Potamogeton richardsonii</i> A. Benn.	1a|		
<i>Potamogeton robbinsii</i> Oakes	1a|		
<i>Potamogeton spirillus</i> Tuckerm.	1a|2|		
<i>Potamogeton vaginatus</i> Turcz.	1a|		
<i>Potamogeton zosteriformis</i> Fern.	1a|		
<i>Phyllospadix scouleri</i> Hook	1c|		
<i>Ruppia maritima</i> L.	1c|		
<i>Zannichellia palustris</i> L.	1d|		
<i>Zostera marina</i> L.	1c|		
NAJADACEAE			
<i>Najas flexilis</i> (Willd.) R. & S.	1a|2|		
<i>Najas marina</i> L.	1c|2|3|4|5		
<i>Najas minor</i> Allioni	1d|3|4|5		
<i>Najas muenscheri</i> Clausen	1d|3|4|5		
<i>Najas olivacea</i> Rosend. & Butters	1b|		
JUNCACEAE			
<i>Lilaea subulata</i> HBK.	1b|		

EXPLANATION OF SYMBOLS: 1a—Plants of deep fresh water lakes and streams. 1b—Plants of shallow water ponds and marshes. 1c—Plants of salt water and marshes. 1d—Plants of tidal flats of Hudson River. 1e—Plants of acid bogs and margins of acid lakes. 2—Seedlings produced by seeds germinated in water. 3—Plants grown from cuttings in water. 4—Plants grown from cuttings in wet sand. 5—Plants grown from cuttings in wet sphagnum. 0—Species that did not produce any root hairs under the conditions of this experiment.

<i>Scheuchzeria palustris</i> L.	1e	2	3	4	5
<i>Triglochin maritima</i> L.	1c	3	4	5	
<i>Triglochin palustris</i> L.		3	4	5	

ALISMACEAE

<i>Alisma plantago-aquatica</i> L.	2	3	4	5	
<i>Alisma gramineum</i> Gmel.	1b				
<i>Damasodium californicum</i> Torr.	1b				
<i>Echinodorus cordifolius</i> (L.) Griseb.	1b				
<i>Lophocarpus spongiosus</i> (Engelm.) J. G. Smith	1d				
<i>Sagittaria cuneata</i> Sheldon	1b		3	4	5
<i>Sagittaria graminea</i> Michx.	1b				
<i>Sagittaria latifolia</i> Willd.	1b	2	3	4	5
<i>Sagittaria rigida</i> Pursh.	1b				
<i>Sagittaria subulata</i> (L.) Buchenau	1c				

BUTOMACEAE

<i>Butomus umbellatus</i> L.	2				
<i>Hydrocleys nymphoides</i> Buchenau	1b				

HYDROCHARITACEAE

<i>Elodea canadensis</i> Michx.	1a				
<i>Elodea densa</i> Casp.		3		5	
<i>Elodea occidentalis</i> (Pursh) St. John		2	3	5	
<i>Vallisneria americana</i> Michx.	1a	2	3	4	5

GRAMINEAE

<i>Calamagrostis canadensis</i> (Michx.) Beauv.	1b				
<i>Distichlis spicata</i> (L.) Greene	1c		3	4	5
<i>Glyceria borealis</i> (Nash) Batch.	1b				
<i>Glyceria canadensis</i> (Michx.) Trin.	1b				
<i>Glyceria grandis</i> Wats.	1b				
<i>Glyceria melicaria</i> (Michx.) Hub.	1b				
<i>Glyceria obtusa</i> (Muhl.) Trin.	1b				
<i>Glyceria septentrionalis</i> Hitch.					
<i>Glyceria striata</i> (Lam.) Hitch.	2				
<i>Phalaris arundinacea</i> L.		3	4	5	
<i>Phragmites communis</i> Trin.	1c		3	4	5
<i>Spartina alterniflora</i> Loise.	1c				
<i>Spartina pectinata</i> Link.	1b				
<i>Zizania aquatica</i> L.	1d	2			

CYPERACEAE

<i>Carex aquatilis</i> Wahl.	1b				
<i>Carex laxiculmis</i> Schwein.	1b				
<i>Carex rostrata</i> Stokes	1b				
<i>Dulichium arundinaceum</i> (L.) Britt.		3	4	5	
<i>Eleocharis acicularis</i> (L.) R. & S.	1b				
<i>Eleocharis calva</i> Torr.	1b		3	4	5
<i>Eleocharis obtusa</i> (Willd.) Schultes	1b				
<i>Eleocharis palustris</i> (L.) R. & S.	1b				
<i>Eleocharis smallii</i> Britt.	1b				
<i>Eriophorum spissum</i> Fern.	1e				
<i>Eriophorum virginicum</i> L.	1e		3	4	5
<i>Eriophorum virgii-carinatum</i> L.	1b		3	4	5
<i>Eriophorum tenellum</i> Nutt.	1d				
<i>Mariscus mariscoides</i> (Muhl.) Kuntze	1d				
<i>Rhynchospora alba</i> (L.) Vahl	1d				
<i>Scirpus acutus</i> Muhl.	1b				
<i>Scirpus americanus</i> Pers.	1b		3	4	5
<i>Scirpus paludosus</i> Nels.	1c				
<i>Scirpus subterminalis</i> Torr.	1b				
<i>Scirpus validus</i> Vahl.	1b				
<i>Acorus calamus</i> L.	1		3	4	5
<i>Calla palustris</i> L.	0	1	0	0	0
<i>Orontium aquaticum</i> L.	1				

<i>Peltandra virginica</i> (L.) Kunth	1				
<i>Pistia stratiotes</i> L.	0				

LEMNACEAE

<i>Lemna minor</i> L.	1e				
<i>Lemna trisulca</i> L.	1e				
<i>Spirodela polyrrhiza</i> (L.) Schleid.	1e				
<i>Wolffia columbiana</i> Karst.	0				
<i>Wolffia punctata</i> Griseb.	0				
<i>Wolffiella floridana</i> (Smith) Thompson	0				

ERIOCAULACEAE

<i>Eriocaulon septangulare</i> With.	1e				
<i>Eriocaulon parkeri</i> Robinson	2				

XYRIDACEAE

<i>Xyris caroliniana</i> Walt.	1e				
-------------------------------------	----	--	--	--	--

PONTEDERIACEAE

<i>Eichornia crassipes</i> (Mart.) Solms.		3	4	5	
<i>Heteranthera dubia</i> (Jacq.) Macm.	2				
<i>Heteranthera reniformis</i> R. & P.	1d				
<i>Pontederia cordata</i> L.	2				

JUNCACEAE

<i>Juncus articulatus</i> L.	2				
<i>Juncus canadensis</i> J. Gay.	1e				
<i>Juncus gerardi</i> Loise.	1c		3	4	5
<i>Juncus pelocarpus</i> E. Meyer			3	4	5

PIPERACEAE

<i>Saururus cernuus</i>	1	3	4	5	
------------------------------	---	---	---	---	--

POLYGONACEAE

<i>Polygonum amphibium</i> L.		3	4	5	
<i>Polygonum coccineum</i> Muhl.		3	4	5	
<i>Polygonum hydropiperoides</i> Michx.		3	4	5	

CHENOPODIACEAE

<i>Salicornia europaea</i> L.	1c	2	3	4	5
<i>Suaeda maritima</i> (L.) Dumont.	1c		3	4	5

AMARANTHACEAE

<i>Achyranthes philoxeroides</i> (Mart.) Standl.		3	4	5	
<i>Acnida cannabina</i> L.		3	4	5	

CARYOPHYLLACEAE

<i>Spergularia leiosperma</i> (Kindb.) Schmidt	1c				
<i>Spergularia marginata</i> (L.) Kittel	2				

CERATOPHYLLACEAE

<i>Ceratophyllum demersum</i> L.	0	0	0	0	0
---------------------------------------	---	---	---	---	---

NYMPHAEACEAE

<i>Brasenia schreberi</i> Gmel.	1b				
<i>Cabomba caroliniana</i> Gray	1a				
<i>Nelumbo lutea</i> (Willd.) Pers.	1b				
<i>Nymphaea odorata</i> Ait.	1b				
<i>Nymphaea tuberosa</i> Paine		2	3	4	5
<i>Nuphar advena</i> Ait.		2	3	4	5
<i>Nuphar microphyllum</i> (Pers.) Fern.	2				
<i>Nuphar rubrodiscum</i> (Morong) Fern.	1b				
<i>Nuphar variegatum</i> (Englm.) Fern.	2				

RANUNCULACEAE

<i>Ranunculus trichophyllus</i> Choix.	1	3	4	5	
---	---	---	---	---	--

<i>Ranunculus flabellaris</i> Raf. ....	| 3|4|5
<i>Ranunculus longirostris</i> Godr.	1b | | |
<i>Ranunculus reptans</i> L.	1b | | |

CRUCIFERAE

<i>Armoracia aquatica</i> (Eat.)	1b | | |
<i>Wiegand</i> .....	| 2|3|4|5
<i>Nasturtium officinale</i> R. Br.	1b | | |
<i>Subularia aquatica</i> L. ....	| | |

SARRACENTACEAE

<i>Sarracenia purpurea</i> L.	1e|2|3| 5
------------------------------------	-----------

DROSERACEAE

<i>Drosera longifolia</i> L.	1e|2|3|4|5
<i>Drosera rotundifolia</i> L.	1e | | |

PODOSTEMACEAE

<i>Podostemon ceratophyllum</i> Michx. ....	| 0|0|0
---	-------

CRASSULACEAE

<i>Tillaea aquatica</i> L.	1d | | |
---------------------------------	----

ROSACEAE

<i>Potentilla palustris</i> (L.) Scop.	1e| 3|4|5
---	-----------

CALLITRICHACEAE

<i>Callitriche heterophylla</i> Pursh	1b | | |
<i>Callitriche palustris</i> L.	1b | | |

ELATINACEAE

<i>Elatine americana</i> (Pursh) Arnott. ....	| 2| | |
<i>Elatine minima</i> (Nutt.) F. & M.	1b | | |

LYTHRACEAE

<i>Decodon verticellatus</i> (L.) Ell. ....	| 3|4|5
<i>Lythrum salicaria</i> L. ....	| 3|4|5

MELASTOMOCEAE

<i>Rhexia virginica</i> L. ....	| 3|4|5
---------------------------------	-------

ONAGRACEAE

<i>Ludwigia palustris</i> L. ....	| 3|4|5
-----------------------------------	-------

TRAPACEAE

<i>Trapa natans</i> L.	1b | | |
-----------------------------	----

HALORAGIDACEAE

<i>Hippuris vulgaris</i> L.	1b | | |
<i>Myriophyllum exallescens</i> Fern.	1a | | |
<i>Myriophyllum heterophyllum</i> Michx.	1b | | |
<i>Myriophyllum humile</i> (Raf.) Morong	1b | | |
<i>Myriophyllum proserpinacoides</i> Gill.	1b | | |
<i>Myriophyllum tenellum</i> Bigelow.	1b | | |
<i>Proserpinaca palustris</i> L.	1b | | |

UMBELLIFERAE

<i>Lilaeopsis chinensis</i> Michx.	1d | | |
<i>Lilaeopsis occidentalis</i> C. & R.	1d | | |
<i>Sium suave</i> Walt. ....	| 3|4|5

ERICACEAE

<i>Vaccinium macrocarpon</i> Ait.	1e | | |
<i>Vaccinium oxycoccus</i> L.	1e | | |

PLUMBAGINACEAE

<i>Limonium carolinianum</i> (Walt.) Britton.	1c | | |
--	----

PRIMULACEAE

<i>Lysimachia terrestris</i> (L.) BSP. ....	| 3| 5
<i>Lysimachia thyrsiflora</i> L. ....	| 3| 5
<i>Samolus floribundus</i> ....	| 3|4|5

GENTIANACEAE

<i>Menyanthes trifoliata</i> L.	1e | | |
<i>Nymphoides lacunosum</i> (Vent.) Fern.	1b | | |
<i>Nymphoides peltatum</i> Br. & Rendle	1b | | |

SCROPHULARIACEAE

<i>Gratiola aurea</i> Muhl.	1b | | |
<i>Veronica americana</i> Schwein. ....	| 3|4|5
<i>Veronica anagallis-aquaticis</i> L. ....	| 3|4|5
<i>Illysanthes dubia</i> (L.) Barnhart.	1b | | |

LENTIBULARIACEAE

<i>Utricularia geminiscapa</i> Benj.	0 | 0|0|0|0
<i>Utricularia gibba</i> L.	0 | 0|0|0|0
<i>Utricularia intermedia</i> Hayne	0 | 0|0|0|0
<i>Utricularia purpurea</i> Walt.	0 | 0|0|0|0
<i>Utricularia resupinata</i> B. D. Greene	0 | 0|0|0|0
<i>Utricularia vulgaris</i> L.	0 | 0|0|0|0

ACANTHACEAE

<i>Dianthera americana</i> L. ....	| 3|4|5
------------------------------------	-------

PLANTAGINACEAE

<i>Plantago cordata</i> Lam.	1 | 2|3|4|5
<i>Plantago oligantha</i> R. & S.	1c | 3|4|5

RUBIACEAE

<i>Cephalanthus occidentalis</i> L. ....	| 3|4|5
--	-------

LOBELIACEAE

<i>Lobelia dortmann</i> L. ....	| 2| | |
---------------------------------	---

COMPOSITAE

<i>Bidens beckii</i> Torr.	1a | | |
<i>Bidens cernua</i> L.	1b | | |
<i>Bidens bidentoides</i> (Nutt.) Britt.	1b | 3|4|5

EQUISETACEAE

<i>Equisetum limosum</i> L.	1b | | |
----------------------------------	----

ISOETACEAE

<i>Isoetes catoni</i> Dodge	1a | | |
<i>Isoetes muricata</i> Dur.	1a | | |
<i>Isoetes engelmanni</i> A. Br.	1b | | |
<i>Isoetes riparia</i> Engelm.	1b | | |

MARSILEACEAE

<i>Marsilea quadrifolia</i> L.	1b | 3|4|5
<i>Marsilea vestita</i> Hook. & Grev.	1b | | |

LYCOPODIACEAE

<i>Lycopodium inundatum</i> L.	1e | | |
-------------------------------------	----

SALVINIACEAE

<i>Azolla caroliniana</i> Willd.	1b | | |
<i>Salvinia rotundifolia</i> Willd.	0 | | |

PARKERIACEAE

<i>Ceratopteris pteridioides</i> Hook.	1b | | |
---	----

SUMMARY

Aquatic plants from several types of habitats were investigated to determine to what extent they develop root hairs. The plants studied include 11 Pteridophytes, 119 monocotyledons and 79 dicotyledons, a total of 209 species representing 105 genera in 54 families.

Root hairs were found on 195 species (93.3 per cent). Fourteen species (6.7 per cent) produced no root hairs; of these five (2.4 per cent) produced roots but no root hairs; the other nine species (4.3 per cent) produced neither root hairs nor roots.

In 47 of the 54 families included in this study all species investigated produced root hairs. Of the other seven families, in three, Ceratophyllaceae, Lentibulariaceae and Podostemaceae, all species failed to produce roots. In Trapaceae, *Trapa natans* developed roots but no root hairs. In the Lemnaceae two genera, (*Lemna* and *Spirodela*), produced roots but no root hairs and two others (*Wolffia* and *Wolffiella*), do not even produce roots. In the Salviniaceae, *Azolla* produced roots with root hairs and *Salvinia* produced no roots. Of all the families studied the Araceae showed the greatest variation in root hair production; *Pistia* produced no roots; *Calla* produced roots without root hairs; *Acorus*, *Orontium* and *Peltandra* produced roots with root hairs.

Root hairs were found to be produced by the several species in each family even though they grow naturally in such different types of habitats as deep water lakes, shallow lakes or ponds, marshes bordering ponds, salt water, salt marches, tidal mud flats or acid peat bogs. In each family where two or more species, each of which was limited to one of these habitats, were investigated, all or none of the species produced root hairs regardless of the habitat from which it was taken.

Plants of 63 species were propagated under three conditions in the greenhouse, in water, in wet sand, and in moist sphagnum moss. The roots of 60 species produced root hairs under all three conditions. The roots of two species produced root hairs under none of the three treatments. *Pistia stratiotes* produced no roots.

Seedlings of 48 species were grown by germinating seeds in tap water and allowing them to grow from one to four months. Three species, *Ceratophyllum demersum*, *Utricularia vulgaris*, and *Utricularia geminiscapa* produced no roots. Four species, *Orontium aquaticum*, *Calla palustris*, *Trapa natans* and *Scheuchzeria palustris*, produced primary and adventitious roots but no root hairs. All the other 41 species produced root hairs on the primary and adventitious roots when growing in tap water. All the species which produced root hairs in the seedling stage also produced root hairs on mature plants. *Scheuchzeria palustris* was the only species that did not produce root hairs as a seedling but produced them on adventitious roots on mature plants.

The production of root hairs is a characteristic phenomenon for all aquatic species of plants in most of the families investigated. Root hairs are produced by seedlings of nearly all species growing immersed in water and independent of a substratum. The production of root hairs continues in mature plants and in plants growing in various habitats. These investigations do not support

the view that root hairs are infrequent on aquatic plants nor that their production is stimulated when the plants are rooted in a substratum. The observations recorded indicate that most aquatic plants, like terrestrial plants, produce abundant root hairs to increase the absorbing surface of their roots. The roots of aquatic plants like those on the land, in general, still function in the intake of water and solutes as well as for anchorage.

REFERENCES

- BOURN, W. S. 1932—Ecological and physiological studies on certain aquatic angiosperms. Contrib. Boyce Thompson Inst. 4:425-496.
- BROWN, WILLIAM H. 1913—The relation of the substratum to the growth of *Elodea*. Philippine Journal of Science C. Bot. 8:1-20.
- CORMACK, R. G. H. 1937—The development of root hairs by *Elodea canadensis*. New Phytol. 36:19-25.
- FOREL, F. A. 1901—Handbuch der Seekunde. Allgemeine Limnologie (Bibl. Geog. Handbücher herausgegeben von F. Ratzel). Stuttgart.
- FRANK, A. B. 1872—Ueber die Lage und die Richtung schwimmender und submerser Pflanzentheile. Cohn's Beiträge zur Biologie der Pflanzen. Bd. 1. Heft 2. pp. 31-86.
- HOCHREUTINER, GEORGES 1896—Etudes sur les Phanerogames aquatique du Rhone et du port de Geneve. Revue Gen. Bot. 8:158-265.
- LUDWIG, F. 1881—Ueber die Bestäubungsverhältnisse einiger Süsswasserpflanzen und ihre Anpassungen an das Wasser und gewisse wasserbewohnende Insekten. Kosmos (Stuttgart). Jahrg. v. Bd. X. pp. 7-12.
- MCDUGALL, W. B. 1941—Plant Ecology. 285 pp. Phila.
- MUENSCHER, W. C. 1936—Storage and germination of seeds of aquatic plants. Cornell Univ. Agri. Exp. Sta. Bul. 652.
- 1936—The germination of seeds of Potamogeton. Ann. Bot. 50:805-822.
- NOLL, FRITZ. 1903—In Lehrbuch der Botanik für Hochschulen by Strasburger, E., Fritz Noll, H. Schenck and G. Karsten. pp. 197-213. 2nd English Edition.
- POND, R. H. 1903—The biological relation of aquatic plants to the substratum. U. S. Comm. Fish and Fisheries Report. 485-526.
- SACHS, J. 1887—Lectures on the physiology of plants. Oxford.

Further Observations on Forest Invasion and Succession on Basins of Drained Lakes in Northern Minnesota

John B. Moyle

Minnesota Department of Conservation, St. Paul

Etlar L. Nielsen

U.S.D.A., Bureau of Plant Industry, Madison, Wisconsin

During the past 35 years three lakes in northern Minnesota have been partially drained because of logging and mining operations. Drainage exposed several types of soil in the lake basins and on them it has been possible to observe directly forest invasion and succession. The lakes which were drained are: (1) Sunken Lake, near Deer River in Itasca County; (2) Bass Lake, near Ely in St. Louis County; and (3) East Rabbit Lake, near Crosby in Crow Wing County. Bass and Sunken Lakes were partly drained during logging operations when previously impounded water cut troughs through the moraines. East Rabbit Lake was lowered by pumping to expose iron ore deposits in its bed. Sunken Lake was lowered 17 feet* during 1915 and reduced in size from 90 to 62 acres. Bass Lake was lowered 52 feet during 1925 and reduced from 494 to 260 acres. East Rabbit Lake was lowered 30 feet during 1945 and its size reduced from 534 acres to a small shallow sump in the center. The history of Bass and Sunken Lakes together with a description of the physiography and vegetation of the lake basins, as it appeared in 1934 and 1939, was recorded in an earlier paper by the writers (Nielsen and Moyle, 1941). The present paper considers vegetational trends at Bass and Sunken Lakes since 1939 and the earlier stages of plant invasion on drained lake basins as observed at East Rabbit Lake. Field studies, which were made during 1934, 1939, 1949 and 1950, provide information on the status of vegetation on drained lake basins, 5, 9, 14, 24, 25, 34 and 35 years after drainage.

All three lakes are in the northern coniferous forest region. Bass Lake and Sunken Lake are located, respectively, in the Superior and Chippewa National Forests. The latter lake, and adjoining area, has been set aside as a permanent study area. In the forest around Bass and Sunken Lakes the commonest forest trees are Norway pine (*Pinus resinosa* Ait.), jack pine (*P. banksiana* Lamb.), white pine (*P. strobus* L.), White spruce (*Picea glauca* (Moench) Voss), balsam fir (*Abies balsamea* (L.) Mill.), trembling aspen (*Populus tremuloides* Michx.), white birch (*Betula papyrifera* Marsh.), red oak (*Quercus rubra* var. *borealis* (Michx. f.) Farw.), and bur oak (*Q. macrocarpa* Michx.). The general forest aspect at Bass and Sunken Lakes is that of a "pine forest" with Norway pine and jack pine the most common species. Pines are less in evidence at East Rabbit Lake, although some Norway pines are scattered throughout the forest. Here the hardwoods predominate, especially red oak, bur oak, aspen and birch. Around all three lakes the ground cover is of plants typically associated with the northern coniferous forest.

* Previously reported as 33 feet; the height of the impounding moraine.

DRAINAGE OF LAKE BASIN SOILS AND ITS EFFECT ON PLANT SUCCESSION

The effect of lake drainage upon the formerly submerged soils should be considered before discussing vegetational trends. Wilde, Young and Hovind (1950) noted from their work on beaver impoundments in Wisconsin that removal of beaver dams results in drainage of two types: superficial and internal. Superficial drainage is attained almost immediately after the dam is removed. Internal drainage of formerly submersed and saturated soils may require from days to years, depending upon the nature and position of the soils.

The rapidity of drainage and the physical and chemical changes of the soils accompanying drainage, vitally affect plant invasion and succession. This may be contrasted to the classical concept of plant succession whereby the plants themselves gradually change the habitat from the xeric or hydric to a mesic state. In the lake basins here considered changes in the habitat have resulted in a telescoping and overlapping of what are usually considered to be successional stages or seres. There has been a general acceleration of the rate of vegetational change and often an apparent lack of orderly succession as was reported in the earlier paper. For example, such drainage has allowed depauperate plants of the blue flag (*Iris versicolor* L.) and robust jack pine trees to be found growing together. Another odd association is that of the white birch and the sow thistle (*Sonchus arvensis* L.). Similarly, at Bass Lake, sandbar willows (*Salix interior* Rowlee) for some time flourished on ground water seeping from gravel in habitats that are now xeric.

It should be noted also that drainage of formerly submersed soils involves changes other than the removal of water. Submersed soils often contain toxic substances, such as ferrous iron and sulphides. Wilde, et al. (l.c.) found that soils that had been submerged by beaver impoundment inhibited the growth of mycorrhizal fungi and thereby the growth of white pine.

For these reasons forest invasion and succession on drained lake basins can be expected to differ somewhat from that on upland soils, at least for the first few years until internal drainage is completed. The vegetational changes are usually faster than in normal habitats and may deviate somewhat from the usual pattern.

Because the physical nature of a soil determines to a great extent how rapidly it will drain as well as the kinds of plants which can successfully establish themselves upon it, plant invasion and succession are considered separately for each of the four principal soil types studied. They are: (1) coarse inorganic soils; (2) fine inorganic soils; (3) peaty and mucky soils; and (4) raw glacial soils of gully slopes and alluvial fans.

PLANT INVASION AND SUCCESSION ON COARSE IN- ORGANIC SOILS (GRAVEL, RUBBLE, AND COBBLES)

East Rabbit Lake.—The stony beaches at East Rabbit Lake, five years after drainage had stands of birch 2 to 6 feet tall. Among the birch were occasional willow and alder bushes. Ground cover was sparse and mostly of weedy herb such as Canada thistle (*Cirsium arvense* (L.) Scop.), stickweed (*Lap-*

pula sp.), mullein (*Verbascum Thapsus* L.) and smartweed (*Polygonum cilinode* Michx.).

Bass Lake.—A considerable amount of stony soil was exposed along both the south and north shores of Bass Lake. These, when first observed during 1934 (nine years after drainage), were covered by a dense growth of white birch, 6 to 8 feet tall, which grew in the interstices between the stones. Among the birches were occasional willow and alder bushes and small trees of pin cherry (*Prunus pensylvanica* L.f.), balsam poplar (*Populus balsamifera* L.) and aspen. By 1950 (25 years after drainage) the birch had formed almost a pure stand of trees which were from 2 to 7 inches d.b.h. and from 20 to 25 feet tall. A few large and decadent willows survived among them. A fairly thick layer of forest litter had accumulated. Growing with and under the birches on the higher and better drained slopes were scattered Norway pine (2 to 6 inches d.b.h.) and white spruce (4 to 10 feet tall). Occasional small balsam fir trees had also become established where silt and organic soils had accumulated. Herbaceous ground cover was generally sparse under the birch stands in 1950, and consisted mostly of wild strawberry (*Fragaria* spp.), clumps of moss between the stones and scattered and rather spindly plants of pearly everlasting (*Anaphalis margaritacea* (L.) C. B. Clarke), fireweed (*Epilobium angustifolium* L.) and Canada thistle. In moister places, especially toward the bottom of the slopes, many of the typical forest herbs of the region had become established; such as shinleaf (*Pyrola secunda* L. and *P. elliptica* Nutt.).

Along the north shore of Bass Lake the newly-established birch forest is less dense. Here, by 1950, occasional red maple (*Acer rubrum* L.), aspen and balsam fir have appeared, especially on the finer soils toward the bottom of the slopes. Ground cover in this more open birch stand was of occasional patches of poverty oat grass (*Danthonia spicata* (L.) Beauv.), haircap moss (*Polytrichum* sp.), white clover (*Trifolium repens* L.) and sow thistle (*Sonchus arvensis*).

PLANT INVASION AND SUCCESSION ON FINE INORGANIC SOILS (SILT, SAND, AND FINE GRAVEL)

East Rabbit Lake.—The sandy slopes of East Rabbit Lake, five years after drainage, presented a distinctly xeric habitat. They were covered with depauperate weedy annuals such as Russian thistle (*Salsola Kali* L.), peppergrass (*Lepidium* sp.), knotweed (*Polygonum aviculare* L.), and pigeon grass (*Setaria* sp.). With the annual herbs were scattered patches of perennial herbs including sow thistle, dandelion (*Taraxacum* sp.), grass-leaved goldenrod (*Solidago graminifolia* (L.) Salisb.), and white clover. Woody vegetation was limited to occasional willow bushes that had evidently become established when drainage was less complete and to scattered balsam poplar, some of which were as much as 10 feet tall. Remnants of the vegetation of the former littoral zone also persisted here, especially in locations of water seepage. The commonest of such species were reed (*Phragmites communis* Trin.), threesquare (*Scirpus americanus* Pers.), and hardstem bulrush (*Scirpus acutus* Muhl.). The lower sandy slopes, where drainage was less complete, had been colonized by willows and balsam poplar.

Bass Lake.—Drainage of Bass Lake exposed a plain of varved sands and

silt that had formerly underlain the north bay of the lake. When first seen by the writers, during 1934 (nine years after drainage), the silty soils had been invaded by perennial grasses and sedges. The sandy soils had scattered patches of xeric mosses. By 1939 seedlings of white birch, white pine, Norway pine, jack pine, white spruce, aspen, and balsam poplar had appeared. Twenty-five years following drainage (in 1950) about one-fourth of the sand plain was covered by aspen, birch, jack and Norway pine trees, most of which were from 2 to 6 inches d.b.h. The grasses previously noted on the silty soils, especially near the former shoreline, had, by 1950, formed a fairly dense sod in which poverty oat grass, bluegrass (*Poa pratensis* L.), and quackgrass (*Agropyron repens* (L.) Beauv.) were the principal components. On the sandy soils not colonized by trees the herbaceous vegetation remained patchy and consisted mostly of haircap moss, quackgrass, panic grass (*Panicum lanuginosum* var. *Lindheimeri* (Nash) Fern.), bluegrass, pearly everlasting, alsike clover (*Trifolium hybridum* L.), white sweet clover (*Melilotus alba* Desr.), and sow thistle along with occasional strawberry, goldenrod, hawkweed, and *Antennaria* plants.

Gullying of the varved sands and silts of the sand plain began with or soon after drainage. The larger gullies, which had little vegetation in 1939, were by 1950 filled with large willow bushes. Cattails and other emergent aquatic plants grew in the bottoms and the scouring rush (*Equisetum hyemale* L.) formed dense mats on the gully sides. *Malaxis unifolia* Michx., a comparatively rare orchid in Minnesota, was fairly abundant on the gravelly soils about Bass Lake.

Sunken Lake.—An older stage of the vegetation on sandy soils is found at Sunken Lake. Here, in 1950 (35 years after drainage) the sandy soils were covered with Norway and jack pine (4 to 10 inches d.b.h.). Among the pines were occasional white birch and balsam poplar (1 to 3 inches d.b.h.) and red oak seedlings. The balsam poplar growing under the pine had an unthrifty appearance. Ground cover plants beneath the pines at Sunken Lake were scattered but mostly of typical pine-forest plants such as bearberry (*Arctostaphylos Uva-ursi* (L.) Spreng.), bluebell (*Campanula rotundifolia* L.), mountain rice (*Oryzopsis asperifolia* Michx.), sedge (*Carex pensylvanica* Lam.), and twin flower (*Linnaea borealis* var. *americana* (Forbes) Rehd.). Occasional depauperate plants of blue flag (*Iris versicolor* L.) still survived beneath the pines; relicts from the time when the sand was poorly drained.

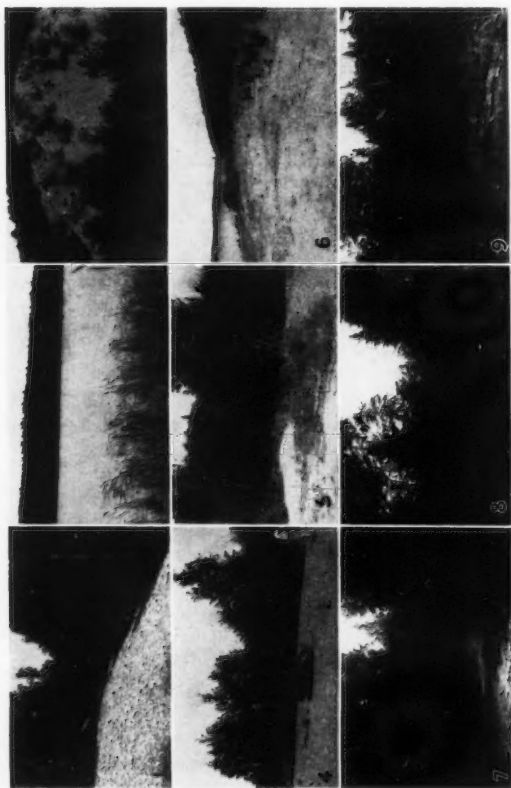
Along the southeast shore of Sunken Lake silty soils were exposed and contained a considerable amount of organic matter. In 1950 these soils supported aspen and birch trees that averaged about 8 inches d.b.h. Beneath them were old willow bushes and some reproduction of aspen and balsam poplar. There was a fairly dense understory of red raspberry (*Rubus idaeus* var. *strigosus* (Michx.) Maxim.) and American hazel (*Corylus americana* Walt.) beneath which were scattered and unthrifty plants of Canada thistle and sow thistle.

PLANT INVASION AND SUCCESSION ON ORGANIC SOILS (MUCK AND PEAT)

East Rabbit Lake.—Drainage of East Rabbit Lake exposed mucky soils of the former lake bed. These, five years after drainage, were still wet and

covered with a dense growth of willows that varied from 8 to 12 feet in height. Beneath and between the willows were such moisture-loving perennial herbs as reed canary grass (*Phalaris arundinacea* L.), wool-grass (*Scirpus atrocinctus* Fern.), grass-leaved goldenrod and swamp milkweed (*Asclepias incarnata* L.). Cattails (*Typha latifolia* L. and *T. angustifolia* L.), sweet flag (*Acorus Calamus* L.) and other emergent aquatic herbs flourished at the edge of the sump but occurred only as stunted and scattered individuals beneath the willows.

Sunken Lake.—The center of the drained south arm of Sunken Lake has a soil of mucky lake deposits. When first seen by the writers in 1934, the better drained portions of these soils were covered with aspen that were mostly 14 and 15 years old. Scattered among the aspen were seedlings of white spruce and red oak. The aspen had grown to a height of 30 feet and were from 4 to 8" d.b.h. by 1950 (35 years after drainage). Under the aspen



Figs. 1-9. Vegetation at Bass and Sunken Lakes in 1949.—1. Cobble pavement of former beach level at Bass Lake, the birches to the right are growing on coarse gravel and cobbles of the former lake bottom. 2. South shore of Bass Lake, the former shoreline is nearly obliterated by the invading birch forest. 3. South-facing slope of gully between Bass and Low lakes. 4. Young birch trees growing in troughs of coarse sand and gravel ripples of the delta at the outlet of gully at Bass Lake. 5. Herbs and birch trees in troughs of sand ripples of the delta at outlet of gully at Bass Lake. 6. Fine-sand plain with scattered herbs and balsam poplar on delta below gully at Bass Lake. 7. Former beach at Sunken Lake with old forest on right and invading jack pine stand on left. 8. South-facing slope of gully at Sunken Lake on right whereon pines are becoming established. 9. Young birch, Norway pine, and white pine growing with scouring rushes on delta below gully at Sunken Lake.

were scattered white spruce trees, 4 to 8 feet tall. Ground cover was mostly of red raspberry bushes.

Before the level of Sunken Lake was lowered, the northern part of the south arm was fringed by a floating heath-sphagnum mat. Leatherleaf (*Chamaedaphne calyculata* (L.) Moench) and bog rosemary (*Andromeda glaucophylla* Link) were the most common components. Drainage dropped this floating heath mat upon the former lake bottom. It is evident that the heath-sphagnum mat drained slowly because in 1939 the heaths were still flourishing although most of the sphagnum was dead. *Andromeda* has disappeared by 1950 and most of the *Chamaedaphne* plants were either dead or dying.

Prior to the lowering of the lake level scattered tamarack trees (*Larix laricina* (DuRoi) K. Koch) and black spruce (*Picea mariana* (Mill.) BSP.) grew upon this floating mat. Growing among them in 1934 were small jack pine, Norway pine, white pine and white spruce. Jack pines were the most common of these invading trees. The old tamarack and black spruce were still thriving in 1950 but the site was dominated by pines up to a foot in diameter. The forest reproduction and smaller trees were also mostly pines.

PLANT INVASION AND SUCCESSION ON RAW GLACIAL SOILS OF SPECIAL LOCATIONS

The special habitats considered are of 2 kinds: (1) the sides of the large gullies or cuts formed in the moraines which formerly impounded the water and maintained the previous lake levels, and (2) the alluvial fans formed by the deposition of morainic material that was transported and sorted by water. Such sites occur only at Bass and Sunken Lakes.

Gully slopes.—At both Bass and Sunken Lakes the cut or gully through the impounding moraine is oriented in an east-west direction causing both north-facing and south-facing slopes of raw glacial soil to be exposed. These slopes, because they stand at the angle of repose, are quite unstable and are difficult habitats for plants to invade. The south-facing slope of the Bass Lake gully had little vegetation upon it in 1934. The principal species noted were sandbar willow near the top of the cut and a few small trembling aspens, large-toothed aspens (*Populus grandidentata* Michx.), white birches and pin cherries.

Where large rocks had stabilized the slopes there were also occasional shrubs of such species as *Diervilla lonicera* Mill., *Lonicera canadensis* Bartr., *Acer spicatum* Lam. and *Rhus Toxicodendron* L. The general picture was similar during 1950 except that the birch and aspen toward the top of the gully were now 2 to 5 inches d.b.h. and a few Norway pine had become established. The south-facing gully slope at Sunken Lake is of a finer soil than at Bass Lake and contains few rocks. When first seen during 1934 this slope had a fairly complete cover of scouring rush (*Equisetum hyemale*) and scattered sandbar willows. This slope had changed little by 1950 except that sandbar willows had become rare and some balsam fir and Norway pines had become established.

North-facing slopes at both Sunken and Bass Lakes presented a more favorable site for establishment of forest trees. Norway pines were estab-

lished and making a good growth at both lakes during 1950.

Alluvial fans.—At Bass Lake, revegetation of the alluvial fan has been uneven because of the giant ripples which were formed at right angles to the current when the fan was deposited. These giant ripples have been described in some detail by Thiel (1932a, 1932b). The moist bottoms of the ripple troughs and the finer soil of the edge of the fan present the most favorable habitats for plant invasion. By 1934, willows, alders, and small birch, aspen and balsam poplars were noted in the troughs. Some of the birch and aspen trees had reached a height of 16 to 18 feet by 1949, but most of the conifers noted earlier had disappeared. Little vegetation was found on the rock and drier parts of the fan either in 1934 or 1950. The principal change in this period of time was the appearance of a few white pine seedlings where soil and forest duff had accumulated between the boulders and cobbles.

The alluvial fan below the morainic cut at Sunken Lake is nearly level and is composed of sand and fine gravel. Here, in 1934, scouring rushes (*Equisetum hyemale* and *E. arvense*) were abundant enough to form, in places, a sod-like cover. Growing among the scouring rushes were many small Norway pine, birch, aspen, balsam poplar, and pin cherry. These trees were about 20 feet tall by 1950 and under them seedlings of balsam fir and red oak had appeared. Near the edge of the fan, adjacent to the old and partly buried cedar swamp, seedlings of white cedar (*Thuja occidentalis* L.) were noted. A layer of forest duff has accumulated over much of the alluvial fan.

SUMMARY AND DISCUSSION

Direct observation of plant invasion and succession on the basin of three drained lakes in the coniferous forest region of northern Minnesota emphasizes the influence of soil type and drainage. From the information gathered it appears that plant succession on the several soil types studied is as follows:

On coarse, inorganic soils such as coarse gravel, rubble, and small boulders the first plants to appear are weeds that have wind-blown seeds. These include the Canada thistle, sow thistle, and fireweed. Willows and alders appear at about the same time in the moister places. These pioneers are followed shortly by white birch with occasional aspen and balsam poplars. The birches tend to dominate in nearly pure stands and eventually shade out the willows, alders, and weedy herbs. In the more open birch stands, pines establish themselves on the coarser and better-drained soils. White spruce and balsam fir invade the finer and moister soils of the denser birch stands. Balsam fir and white spruce can establish themselves after a dense birch canopy has developed, but the pines probably cannot.

On fine inorganic soils such as sand and silt, wet soil herbs appear shortly after lake drainage. These are accompanied by or are soon followed by willows. On sand, as the soil drains, dry soil herbs appear together with pines and occasional broad-leaved trees. The pines thrive, but it requires at least 25 years for typical pine-forest ground cover to develop. On silty soils, aspen and birch usually follow the willow stage on the moist sites. There is evidence that the aspen and birch will eventually be replaced by or be associated with balsam fir and white spruce. On drier sites, silty soils develop a sod of perennial grasses. These, judging from conditions at Bass Lake eventually will be replaced by pine.

On organic soils two types of plant succession were observed. The first plants to appear on peaty lake bottoms, which drain slowly, are emergent aquatics such as cattails. These are followed by willows and coarse marsh herbs which are in turn replaced by aspen as the soil dries out. Present evidence suggests that white spruce will eventually replace the aspen. On drained heath mats pines are the initial invaders. They thrive well in this habitat and eventually replace the bog forest trees.

The most successful invaders on steep slopes of raw glacial soils or on water-worked glacial soils are the scouring rushes, especially *Equisetum hyemale*. Common open-ground weeds also appear early but usually make poor growth. On the finer glacial soils the common forest trees, especially the pines, soon become established. On coarse glacial soils, probably because of excessive drainage, revegetation is slow except in depressions where water is available. Here the sequence of vegetation is similar to that on the coarser sands of the drained lake basins.

There has been a considerable amount of work done and some divergence of opinion on the nature of the forest climax and the ecological status of the pine forest in northern Minnesota. For summarization the reader is referred to the papers of Grant (1934) and Eyre and Zehngraft (1948). Since the soils of the drained lake basins have been exposed from 5 to 35 years it is obvious that the forests upon them are still developing and it will be many years before the ultimate or climax forest type can be determined by direct observation. However, some points concerning forest succession and dynamics on these areas are worth noting. (1) It appears that Norway and jack pine which can establish themselves soon after drainage on inorganic soils and loose peat, are not the climax type. It is likely that in the areas studied the pines will be replaced by, or at least be associated with, balsam fir, white spruce, white birch, and red oak. (2) Judging from present observations and from the literature, jack and Norway pine are the most successful in establishing themselves following catastrophic events by which organic soil and an abundance of light are made available to the seedlings—such events as fires, windfalls and, in the present case, sudden lake drainage. (3) On basins of drained lakes there is much overlapping and telescoping of the usual plant-succession stages because of soil drainage.

REFERENCES

- EYRE, F. H. AND PAUL ZEHNGRAFT 1948—Red pine management in Minnesota. U.S.D.A. Circular No. 778; 70 pp.
- GRANT, M. L. 1934—The climax forest community in Itasca County, Minnesota, and its bearing upon the successional status of the true community. *Ecology* 15:243-247.
- NIELSEN, E. L. AND J. B. MOYLE 1941—Forest invasion and succession on the basins of two catastrophically drained lakes in northern Minnesota. *Amer. Midl. Nat.* 25(3):564-579.
- THIEL, G. A. 1932—Giant current ripples in coarse fluvial gravel. *Journ. Geol.* 40:452-458.
- 1932b—Glacio-lacustrine sediments reworked by running water. *Journ. Sed. Petrol.* 2(2):68-75.
- WILDE, S. A., C. T. YOUNGBERG AND J. H. HOVIND 1950—Changes in composition of ground water, soil fertility, and forest growth produced by construction and removal of beaver dams. *J. Wildl. Manag.* 14(2):123-128.

A Check-list of Ferns and Flowering Plants of the Quetico-Superior Wilderness Research Center

Olga Lakela

University of Minnesota, Duluth Branch, Duluth

The Quetico-Superior Wilderness Research Center is at $91^{\circ}36'91^{\circ}41'$ W. longitude and $48^{\circ}48'1'$ N. latitude, Basswood Lake, northwestern Lake County, Minnesota. In the Superior National Forest, approximately twenty miles from Ely and the nearest roads, it borders the southern edge of the Quetico Provincial Park, Ontario. Proximity map, Fig. 1.

The vast territory of the Quetico-Superior area on the Canadian side is almost undisturbed by man. On the side of the United States, it was lumbered between 1885 and 1915, but since that time it has been free from destructive agencies and there remain isolated stands of virgin forest, such as the site of the Research Center.

The Quetico-Superior Wilderness Research Center was conceived, estab-



Fig. 1.—Location of Quetico-Superior Wilderness Research Center.

lished and financed by an individual, anonymous by preference, who believes that the prime values of nature not only uplift and ennoble human thought and conduct but promote physical well-being by improving health. Therefore, its projected program is centered on preservation of the areas where primitive conditions obtain and on restoration of those, disturbed, in the belief that wilderness values are essential to man's intellectual, spiritual and recreational activities—values for which there is no substitute in mechanized civilization.

Thus, at a cross-roads of the voyageur's highway, along the everflowing waters in the continental vastness of North America, there stands a Wilderness Research Center. Over the practices of the ruthless despoiler, it stands in triumph of man's constructive ideals, embodied in living nature, in the fearless tread of deer and grouse; in the rock-rimmed shores laden with verdure; in streams plunging into mist in their time-worn channels of granite; in the green forest of towering pines, nature's living records of the past, where amidst rising vapors, in many a sunlit aisle sings the hermit thrush in sheer enjoyment of its age-old haunts, Fig. 2.

RESEARCH PROGRAM

In conformance with the objectives of the Wilderness Research Center, a research program comprising various aspects of natural history, e.g. ecology and entomology, are underway. Scientists, internationally, are welcomed to avail themselves of the facilities offered by the Research Center, for making contributions to knowledge of wilderness values. Any considerable project must be approved by an informal committee of scientists from the University of Minnesota.

Outstanding is the project in forestry research under the supervision of Mr. Clifford Ahlgren, Resident Forester. A plantation of 165,000 native conifers in annual increments since 1938 affords continuity of study in forest growth under scientific methods and management, Fig. 3.

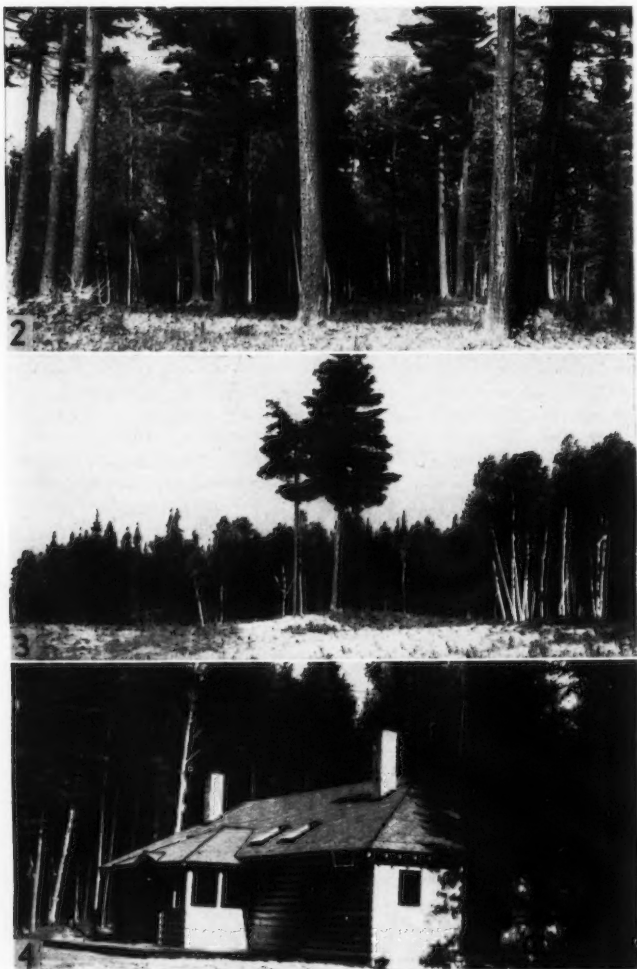
VEGETATION AND THE HERBARIUM PROJECT

The study of the floristics and the making of the herbarium were initiated in 1949. Mr. Ahlgren and his associates have collected in the immediate surroundings of the Research Center and have made occasional forays into Quetico-Provincial Park and Superior National Forest, including Seven Beaver Lake, the headwaters of St. Louis River. An herabrium of over fifteen hundred sheets has been accumulated, representing ferns, fern allies and flowering plants. The collections are housed in the Forestry Building, Fig. 4, in attractive cases constructed by simple carpentry from native lumber. Vegetation on the whole is typical of the coniferous forest region. Duplicates of the collections have been donated to Universities of Toronto and Minnesota.

During this study came to attention a few interesting facts regarding plant distribution. The finding of *Cornus canadensis* f. *florulenta* Lak. in the Quetico-Superior area extends its range into the interior from Lake Superior coast¹ in St. Louis County. At Basswood Lake, it occurs in association with

¹ Lakela, O. *Rhodora* 50:306. 1948.

the typical form and *f. ramosa* lePage, on a pine ridge, on the Research Center grounds. *Sisyrinchium angustifolium* Mill. was reported for the state under the specific epithet, *S. graminoides* Bickn., collected on the North Shore of



Figs. 2-4.—2. Typical habitat of the hermit thrush. 3. Plantation of native conifers. 4. Forestry building housing the herbarium.

Lake Superior,² within the city limits of Duluth. Its occurrence in the wilderness area is the second known locality for the state. The species was discovered growing in Jack pine forest near the north end of the Four-Mile portage west of the road. *Trientalis borealis* Raf. f. *pluriverticillata* Marie Victorin & Rolland, collected in mixed coniferous forest near the Back Bay, and *Lepidium campestre* R. Br. collected from the plantation at the Research Center, appear to be unreported from the state. Mr. Ahlgren discovered *Juncus stygius* var. *americanus* at Seven Beaver Lake, the headwaters of St. Louis River. Known to this writer, there is only one previous collection of this *Juncus* in the Herbarium of the University of Minnesota at Minneapolis, that of Dr. L. H. Bailey some 50 years ago and that also from "St. Louis River." Whether it came from the same area where Mr. Ahlgren collected is not known.

The following check-list is based on accessional sheets in the Herbarium of the Research Center. There are altogether 574 taxa, representing 255 genera and 87 families. The given collection numbers are those of Mr. Ahlgren unless prefixed by "L," signifying the writer's collections. The nomenclature is according to *Gray's Manual of Botany*, eighth edition.

PTERIDOPHYTA—Ferns and Fern-allies

- Equisetum arvense* L. 1462, Field horsetail
E. fluviatile L. 354, 1094, Water horsetail
E. palustre L. 116, Marsh horsetail
E. pratense Ehrh. 639, 640, Meadow horsetail
E. sylvaticum L. 51, 134, Woodland horsetail
Lycopodium annotinum L. 47, 1102, Interrupted clubmoss
L. clavatum L. 899, Running clubmoss
L. clavatum var. *monostachyon* Grev. & Hook. 1144, One-spiked running clubmoss.
L. complanatum L. 67, 1083, Trailing clubmoss
L. lucidulum Michx. 145, L13894, Shiny clubmoss
L. obscurum L. var. *dendroideum* (Michx.) D. C. Eaton 48, Ground Pine
Selaginella rupestris (L.) Spring. 319, Spikemoss
Isoetes muricata Dur. 829, Spiny quillwort
Botrychium multifidum (Gemel.) Rupr. f. *dentatum* Tryon 2016, Leathery grape fern
B. virginianum (L.) Sw. 190, Grape fern
Osmunda cinnamomea L. 295, 849 Cinnamon fern
O. claytoniana L. 100, 638, Interrupted fern
O. regalis L. var. *spectabilis* (Willd.) Gray 94, 227, Royal fern
Athyrium filix-femina (L.) Roth var. *michauxii* (Spreng.) Farw. 130, 1019, lady fern
A. filix-femina var. *michauxii* f. *rubellum* (Gilbert) Farw. L13624
Cystopteris fragilis (L.) Bernh. 178, 387, Brittle bladder-fern
Dryopteris cristata (L.) Gray 1452, Crested shield fern
D. disjuncta (Ledeb.) C. V. Morton 153, 893, Oak-fern
D. fragrans (L.) Schott var. *remotiuscula* Komarov L3077, Fragrant cliff fern
D. phegopteris (L.) Christens. 377, Beech fern
D. spinulosa (O. F. Muell.) Watt 197, 1091, Common shield fern
D. thelypteris (L.) Gray var. *pubescens* (Lawson) Nakai 268, Marsh shield fern
Onoclea sensibilis L. 114, Sensitive fern
Polypodium virginianum L. 58, Cliff fern
Pteridium aquilinum (L.) Kuhn. var. *latiusculum* (Desv.) Underw. 132, 650, Brake fern
Woodisia ilvensis (L.) R. Br. 321, 1095, Rusty Woodsia

² Lakela, O. Ibid. 46:20, 1944.

SPERMATOPHYTA—Flowering Plants

GYMNOSPERMAE

- Taxus canadensis* Marsh. 1167, American Yew
Abies balsamea (L.) Mill. 651, 823, Balsam fir
Larix laricina (DuRoi) K. Koch. 20, 723, Tamarack
Picea glauca (Moench) Voss 9, 630, White spruce
P. mariana (Mill.) BSP. 10, 492, Black spruce
Pinus banksiana Lamb. 22, 491, Jack pine
P. resinosa Ait. 626, Red pine
P. strobus L. 8, 112, White pine
Juniperus communis L. var. *depressa* Pursh 994, 1132, Ground juniper
Thuja occidentalis L. 1, 786, White cedar

ANGIOSPERMAE

MONOCOTYLEDONAE

- Typha latifolia* L. 39, 300, Common cat-tail
Sparganium angrocladum (Engelm.) Morong 623, Greater bur-reed
S. angustifolium Michx. 913, 1056, Narrow-leaved bur-reed
S. chlorocarpum Rydb. var. *acule* (Bebb.) Fern. 224, Green-fruited bur-reed
S. fluctuans (Morong) Robins. 712, 959, Floating bur-reed
S. minimum (Hartm.) Fries 1330, Least bur-reed
Potamogeton alpinus Balbis. var. *tenuifolius* (Raf.) Oden 234, Northern pondweed
P. amplifolius Tuckerm. 445, 1163, Large-leaved pondweed
P. epiphydus Raf. 949, 1052, Ribbon leaf
P. friesii Rupr. 528, Fries' pondweed
P. foliosus Raf. L. 15709, Leafy pondweed
P. gramineus L. 934, 1010, Variable pondweed
P. natans L. 967, Floating pondweed
P. praelongus Wulf. 713, White-stem pondweed
P. pusillus L. 1096, Dwarf pondweed
P. richardsonii (Benn.) Rydb. 863, 1055, Richardson's pondweed
P. robbinsii Oakes 693, Robbins' pondweed
P. spirillus Tuckerm. 562, 566, Spiral-seed pondweed
P. strictifolius Benn. 527, Straight leaf pondweed
P. zosteriformis Fern. 739, 1045, Eel-grass pondweed
Najas flexilis (Willd.) Rostk. & Schmidt 1044, 1079, Slender naiad
Scheuchzeria palustris L. var. *americana* Fern. 243, 817, Marsh Scheuchzeria
Alisma subcordatum Raf. 287, 537, Common water-plantain
Sagittaria cuneata Sheld. 968, Arrow-head
S. latifolia Willd. 743, 956, Duck-potato

- S. latifolia* f. *gracilis* (Pursh) Robins. 883, Slender duck-potato
S. rigida Pursh 533, 964, Sessile-fruited arrowhead
Elodea canadensis Michx. 525, Common waterweed
Vallisneria americana Michx. 957, 1098, Tapegrass
Agropyron repens (L.) Beauv. 117, 183, Quick grass
A. trachycaulum (Link.) Steud. 306, 1087, Slender wheat grass
Agrostis alba L. 244, 376, Red-top
A. scabra Willd. 370, 774, Tickle grass
Alopecurus aequalis Sobol. L13885, Short-awned foxtail
Andropogon gerardi Vitman 581, 1164, Tall bluestem
Bromus ciliatus L. 214, 487, Fringed Brome grass
Calamagrostis canadensis (Michx.) Beauv. 702, 921, Blue-joint grass
Cinna latifolia (Trev.) Griseb. 1126, Wood reedgrass
Danthonia spicata (L.) Beauv. 834, 930, Wildoat-grass
D. spicata var. *pinetorum* Piper L15681
Deschampsia caespitosa (L.) Beauv. var. *glauca* (Hartm.) Lindm. f. 926, 1130, Hair grass
Echinochloa pungens (Poir.) Rydb. 541, Barnyard grass
Elymus canadensis L. 779, 1223, Nodding wild rye-grass
Festuca saximontana Rydb. 195, 415, Slender fescue grass
Glyceria borealis (Nash) Batch. 294, 1046, Northern Manna grass
G. canadensis (Michx.) Trin. 917, 1041, Rattlesnake grass
G. fernaldii (Hitchc.) St. John, 1599, Ditch Manna grass
G. grandis S. Wats. 762, Tall Manna grass
G. striata Hitchc. 176, 384, Nerved Manna grass
Hierochloa odorata (L.) Beauv. L12565,

- Sweet grass
Hordeum jubatum L. 1636, Wild barley
Lolium multiflorum Lam. 605, Darnel
L. perenne L. 726, Perennial darnel
Milium effusum L. var. *cisatlanticum* Fern. 1658, Millet grass
Muhlenbergia glomerata (Willd.) Trin. L15696, Cluster satin grass
M. mexicana (L.) Trin. 987, 1018, Satin grass
Oryzopsis asperifolia Michx. 60, Rough-leaved Mountain-rice
O. pungens (Torr.) Hitchc. 63, Slender Mountain-rice
Panicum boreale Nash 931, Northern panic grass
P. capillare L. L13884, Witch grass
P. depauperatum Muhl. 312, Stunted panic grass
P. lanuginosum L. var. *fasciculatum* (Torr.) Fern. 158, 856, Hairy panic grass
P. xanthophyllum A. Gray 1073, 1086, Large-fruited panic grass
Phalaris arundinacea L. 105, 464, Reed-canary grass
Phleum pratense L. 107, 866, Timothy
Phragmites communis Trin. var. *berlandieri* (Fourn.) Fern. 938, Reed
Poa annua L. 191, 262, Annual June grass
P. compressa L. 106, Canada Blue grass
P. palustris L. 701, 694, Fowl meadow grass
P. pratensis L. 755, June grass
P. saluensis Fern. & Wieg., 1336
Schizachne purpurascens (Torr.) Swallen, 108, 1072, False Melic grass
Setaria viridis (L.) Beauv. 141, Green foxtail
Spartina pectinata Link 1060, Cord grass
Zizania aquatica L. var. *angustifolia* Hitchc. 741, 1001, Wild rice
Z. aquatica L. var. *interior* Fassett 1191, Wild rice
Carex adusta Boott 697, 799, Stiff sedge
C. aenea Fern. 700, 886, Hay sedge
C. angustior Mackenz. 446, 918, Narrow-fruited sedge
C. arcata Boott L13655, Clustered sedge
C. arcata Boott 703, 1081, Drooping sedge
C. brunnescens (Pers.) Poir. 104, 695, Brown-sedge
C. canescens L. var. *suboliaceae* (Lae-stad.) Hartm. 375, 791, Silver-sedge
C. castanea Wahlenb. var. *knieskernii* (Dew.) Mackenz. 668, 707, Chestnut-sedge
C. chordorhiza L. 259, Creeping sedge
C. crawfordii Fern. 143, 867, Crawford's sedge
C. cristatella Britt. 245, Crested sedge
C. deweyana Schwein. 710, 808, Dewey's sedge
C. diandra Schrank 446, Panicked sedge
C. disperma Dew. 146, 898, Soft-leaved sedge
C. flava L. var. *fertilis* Peck 932, Lesser Yellow sedge
C. gracillima Schwein. 267, 825, Graceful sedge
C. houghtonii Torr. 682, 756, Houghton's sedge
C. interior Bailey 188, Inland sedge
C. intumescens Rudge 874, Inflated sedge
C. lacustris Willd. 273, 1041, Lake sedge
C. lanuginosa Michx. 654, Woolly sedge
C. laricina Mackenz. 918, Beaded sedge
C. lasiocarpa Ehrh. var. *americana* Fern. 970, 1048, Slender sedge
C. lenticularis Michx. 787, Lenticular sedge
C. leptalea Wahlenb. 269, Bristle-stalked sedge
C. limosa L. 1977, Mud sedge
C. normalis Mackenz. 344, Straw sedge
C. oligosperma Michx. 256, 818, Few-fruited sedge
C. pauciflora Lightf. 148, 261, Few-flowered sedge
C. paupercula Michx. 252, Bog sedge
C. peckii Howe 653, Peck's sedge
C. pedunculata Muhl. 57, Stalked-sedge
C. pennsylvanica Lam. 1178, Pennsylvania sedge
C. projecta Mackenz. 271, Neck-lace sedge
C. retrorsa Schwein. 206, Turn-back sedge
C. rostrata Stokes 943, 972, Beaked sedge
C. scoparia Schkuhr 1061, Pointed Broom sedge
C. stipata Muhl. 124, 144, Awl-fruited sedge
C. stricta Lam. 721, 969, Tussock sedge
C. strictior Dew. 910, Stiff tussock sedge
C. tenera Dew. 907, Slender sedge
C. tenuiflora Wahlenb. 1511, Sparse-flowered sedge
C. tonsa (Fern.) Bickn. L13888, Deep-green sedge
C. tribuloides Wahlenb. 796, 981, Blunt broom sedge
C. trisperma Dew. 820, Three-fruited sedge
C. tuckermanni Dew. 240, 285, Hop-fruited sedge
C. vaginata Tausch. 1505, 1453, Sheathed-sedge
C. vesicaria L. 947, Bladder sedge

- C. vulpinoidea* Michx. 705, Fox sedge
Dulichium arundinaceum (L.) Britt. 911, 1047, Three-way sedge
Eleocharis acicularis (L.) R. & S. L13626, Slender club-rush
E. calva Torr. 1303, Lesser club-rush
E. palustris L. 1005, Swamp club-rush
E. smallii Britt. 715, 940, Greater club-rush
Eriophorum angustifolium Honck. 978, Common cotton-grass
E. spissum Fern. 250, 459, Hare tail
E. tenellum Nutt. 272, Slender cotton-grass
Rhynchospora alba (L.) Vahl 1914, Beak-rush
Scirpus acutus Muhl. 716, Stiff bulrush
S. atrocinctus Fern. 469, 1026, Leafy bulrush
S. atrocinctus var. *brachypodus* (Fern.) Blake L13632
S. cyperinus (L.) Kutnh var. *pelius* Fern. 544, 990, Wool Rush
S. cyperinus var. *pelius* f. *condensatus* (Fern.) S. F. Blake L13656
S. fluviatilis (Torr.) Gray 437, River bulrush
S. pedicellatus Fern. 889, Stalked bulrush
S. subterminalis Torr. 1094, Water bulrush
S. torreyi Olney 946, Torrey's bulrush
S. validus Vahl var. *creber* Fern. 937, 984, Great bulrush
Acorus calamus L. 553, Sweet flag
Calla palustris L. 680, 997, Wild Calla lily
Lemna minor L. 202, Lesser duckweed
Spirodela polyrhiza (L.) Schleid. 203, Greater duckweed
Eriocaulon septangulare With 915, Pipewort
Juncus balticus Willd. var. *littoralis* Engelm. 149, Shore rush
J. bufonius L. 631, Toad rush
J. effusus L. var. *pylaci* (Laharpe) Fern. & Wieg. L13667, Soft rush
J. filiformis L. 372, 1099, Thread rush
J. stygius L. var. *americanus* Buchen. 1913
J. tenuis Willd. 854, 1076, Slender rush
J. vaseyi Engelm. 358, Vasey's rush
Alium stellatum Fraser 1183, Prairie Wild onion
Clintonia borealis (Ait.) Raf. 368, 901, Yellow Clintonia
Maianthemum canadense Desf. 76, 895, False-lily-of-the-valley
Smilacina trifolia (L.) Desf. 815, False Solomon's seal
Smilax lasioneura Hook. 334, Greenbrier
Streptopus roseus Michx. var. *longipes* (Fern.) Fassett 882, 902, Twisted-stalk
Trillium cernuum L. 518, 622, Wake-robin
Uvularia grandiflora Smith 1011, Greater bellwort
U. sessilifolia L. 497, 516, Cream bells
Iris versicolor L. 850, 977, Blue flag
Sisyrinchium angustifolium Mill. 151, Blue-eyed grass
S. montanum Greene 1622, 1478, Common blue-eyed grass
Corallorhiza maculata Raf. 1075, 1166, Spotted coral-root
Goodyera repens (L.) R. Br. var. *ophioides* Fern. L11740, Lesser Rattlesnake Plantain
G. tessellata Lodd. 1177, 1082, Tesselated Rattlesnake plantain
Habenaria dilatata (Pursh) A. Gray var. *media* (Rydb.) Ames 1532, White rein-orchis
H. hookeri Torr. 780, 920, Hooker's rein-orchis
H. obtusata (Pursh) Rich. 1916, Small bog orchids
H. psychodes (L.) Spreng. 489, 991, Fringed rein-orchis
H. viridis R. Br. var. *bracteata* (Muhl.) A. Gray, Green rein-orchis
Malaxis unifolia Michx. 1093, Adder's mouth
Pogonia ophioglossoides (L.) Ker. 251, 821, Rose Pogonia
Spiranthes cernua Raf. 1915, Nodding ladies' tresses
S. lacera Raf. 1201, Slender ladies' tresses
S. Romanzoffiana Cham. 9-6-52

DICOTYLEDONAE

- Populus balsamifera* L. 98, 729, Balsam poplar
P. grandidentata Michx. 33, -113, Large toothed aspen
P. tremuloides Michx. 13, 87, Trembling aspen
Salix bebbiana Sarg. 7, 80, Beaked willow
S. discolor Muhl. 647, 936, Pussy willow
S. gracilis Anderss. 330, 1151, Slender willow
S. humilis Marsh. 484, Prairie willow
S. lucida Muhl. 35, 495, Shiny willow
S. pedicellaris Pursh var. *hypoglauca* Fern. 357, Bog willow
S. pyrifolia Anders. 1037, Balsam willow
Comptonia peregrina (L.) Coult. 485, 1028, Sweet fern
Myrica gale L. 11, 62, Bayberry
Alnus crispa (Ait.) Pursh 747, 900,

- Green alder
A. rugosa (Du Roi) Spreng. 1030,
 Hoary alder
A. rugosa (Du Roi) Spreng. var. *americana* (Regel) Fern. 465
Betula lutea Michx. f. 38, 482 Yellow birch
B. papyrifera Marsh. 448, White birch
B. papyrifera Marsh. var. *cordifolia* (Regel) Fern. L13810, Heart-leaved birch
B. pumila L. var. *glandulifera* Regel 36, 814, Dwarf birch
Corylus cornuta Marsh. 310, 772, Beaked Hazel
Quercus ellipsoidalis J. E. Hill 302, 1122, Pin Oak
Q. macrocarpa Michx. f. *olivaeformis* (Michx.) Trel. 30, 31, Bur oak
Q. rubra L. var. *borealis* (Michx.) Farw. 303, 1017, Northern red oak
Humulus lupulus L. 1327
Ulmus americana L. 644, White elm
Urtica procera Muhl. 513, Slender stinging nettle
Comandra richardsoniana Fern. 336, 837, Bastard toad-flax
Asarum canadense L. 163, Wild ginger
Polygonum amphibium L. var. *stipulaceum* (Colum.) Fern. L15735, Smartweed
P. amphibium var. *stipulaceum* f. *fluitans* (Eaton) Fern. L15851
P. cilinode Michx. 81, Black bindweed
P. coccineum Muhl. f. *natans* (Wieg.) Stanf. 861, Scarlet smartweed
P. coccineum f. *pratensis* (Greene) Stanf. 613, Shore smartweed
P. douglasii Greene 1025, Douglas' knotweed
P. lapathifolium L. 542, Dock-leaved smartweed
P. persicaria L. 1024, Lady's thumb
P. punctatum Ell. 611, Dotted smartweed
P. ramosissimum Michx. f. *atlanticum* Robins. 293, 386
Rumex acetocella L. 126, Sheep sorrel
R. orbiculatus A. Gray 41, 992, Swamp dock
R. patientia L. 263, 364, Patient dock
R. trianguivalvis (Danser) Reichenb. 594, 868, Pale dock
Chenopodium album L. 535, 1012, Lamb's quarters
C. hybridum L. var. *gigantospermum* (Aellen) Rouleau 478, 601, Maple-leaved goosefoot
C. rubrum L. L15732
Amaranthus retroflexus L. 534, Red root
Mollugo verticillata L. 568, Carpet weed
Claytonia caroliniana Michx. 663, Spring beauty
Arenaria lateriflora L. 1535, Sandwort
Cerastium nutans Raf. 388, Nodding mouse-ear-chickweed
C. vulgatum L. 131, Mouse-ear-chickweed
Lychnis alba Mill. 472, 586, Campion
Silene antirrhina L. 338, Catchfly
Stellaria aquatica (L.) Scop. 609, 749, Water chickweed
S. calycantha (Ledeb.) Bong. 263, Northern stitchwort
S. longifolia Muhl. 210, Common chickweed
S. longipes Goldie 167, 1541, Long-stalked chickweed
Ceratophyllum demersum L. 982, Hornwort
Brasenia schreberi Gmel. 692, 742, Water-shield
Nuphar microphyllum (Pers.) Fern. 1057, Small yellow pond lily
N. rubrodiscum Morong. 444, Ruby pond lily
N. variegatum Engelm. 714, 1063, Greater pond lily
Nymphaea odorata Ait. 968, Fragrant white water lily
Actaea rubra (Ait.) Willd. 655, 672, Red baneberry
A. rubra f. *neglecta* (Cillm.) Robins. 449, White-fruited baneberry
Anemone canadensis L. 1185, Canadian Anemone
A. cylindrica A. Gray 1180, Thimbleweed
A. quinquefolia L. var. *interior* Fern. 54, 1033, Wind anemone
A. virginiana L. 1597, Tall anemone
Aquilegia canadensis L. 367, 781, Columbine
Caltha palustris L. 173, 656, Marsh Marigold
Clematis verticillaris DC. 401, 777, Blue Clematis
Coptis groenlandica (Oeder) Fern. 52, 896, Goldthread
Hepatica americana (DC.) Ker. 643
Ranunculus abortivus L. 748, Small flowered buttercup
R. acris L. 719, Tall meadow buttercup
R. flabellaris Raf. L13889, Yellow water buttercup
R. longirostris Godr. L13629, Stiff water buttercup
R. pensylvanicus L. f. 237, 760, Hairy buttercup
R. reptans L. 281, Creeping buttercup
R. trichophyllus Chaix 233, 941, White water buttercup
T. dasysepalum Fisch. & Lall. 507, 776,

- Tall meadow rue
T. dioicum L. 324, 666, Harly meadow rue
Corydalis aurea Willd. 681, Golden Corydalis
C. sempervirens (L.) Pers. 1067, 1074, Pink Corydalis
Barbarea vulgaris R. Br. 391, 687, Winter cress
Brassica kaber (DC.) L. C. Wheeler var. *pinnatifida* (Stokes) L. C. Wheeler 757, Field mustard
Capsella bursa-pastoris (L.) Medic. 121, Shepherd's purse
Cardamine parviflora L. var. *arenicola* (Britt.) O. E. Schulz 753, Bitter cress
C. pennsylvanica Muhl. 1351, Common cress
Erysimum cheiranthoides L. L15731, Wormseed mustard
Lepidium densiflorum Schrad. 156, Pepperwort
L. campestre E. Br. 686, Field pepperwort
Rorippa islandica (Oeder) Borbas var. *fernaldiana* But. & Abbe 419, 732, Yellow cress
Sisymbrium officinale (L.) Scop. var. *leiocarpum* DC. 1856, Tumbling mustard
Sarracenia purpurea L. 255, Pitcher Plant
Drosera rotundifolia L. 260, Sundew
Heuchera richardsonii R. Br. var. *typica* Rosend., Butt., Lak. 194, 1112, Alum-root
Mitella nuda L. 641, Miterwort
Ribes americanum Mill. 615, Wild black currant
R. glandulosum Weber, 209, 875, Skunk currant
R. hirtellum Michx. 198, Ciliated gooseberry
R. hudsonianum Richards, 509, Northern currant
R. oxycanthoides L. L9036, Northern Gooseberry
R. triste Pall 207, Swamp currant
Saxifraga virginensis Michx. 326, Early Saxifrage
Agrimonia striata Michx. 220, 512, Agrimony
Amelanchier alnifolia Nutt. 1117, Alder-leaved June berry
A. bartramiana (Tausch.) Roemer 56, 1174, Bartram's June berry
A. humilis Wieg. 499, 675, Low June berry
A. intermedia Spach 315, June berry
A. wigandii Nielsen 1110, June berry
Crataegus chrysocarpa Ashe 66, Hawthorn
C. macrosperma Ashe L13890, 1257, Large seeded hawthorn
C. succulenta Link var. *macrantha* (Lodd.) Eggelst. L 15674
Fragaria vesca L. var. *americana* Porter 631, 657
Geum aleppicum Jacq. var. *strictum* (Ait.) Fern. 450, 872, Avens
G. rivale L. 1372, Marsh avens
Potentilla anserina L. 1513, Silver weed
P. argentea L. 758, Silver cinquefoil
P. norvegica L. var. *hirsuta* (Michx.) Lehm. 871, 1108, Rough cinquefoil
P. palustris (L.) Scop. 383, 973, Marsh cinquefoil
P. simplex Michx. 1619, Trailing cinquefoil
Prunus pennsylvanicum L. f. 490, 731, Pin cherry
P. pumila L. 318, 429, Sand cherry
P. susquehanea Willd. 928, 1123, Appalachian cherry
P. virginiana L. 674, Choke cherry
Pyrus americana (March.) DC. 14, 1197, American mountain ash
P. decora (Sarg.) Hyland 683, 1196, Handsome mountain ash
P. melanocarpa (Michx.) Willd. 1021, Choke berry
Rosa acicularis Lindl. 735, 1042, Prickly rose
R. blanda Ait. 725, 1111, Smooth wild rose
Rubus acridens Bailey L15700
R. idaeus L. var. *strigosus* (Michx.) Maxim. 399, Raspberry
R. idaeus var. *canadensis* Rich. 44, Northern raspberry
R. parviflorus Nutt. 608, Thimble-berry
R. pensilvanicus Poir. L. 15699
Spiraea alba Du Roi 43, 960
S. alba f. *rosea* J. W. Moore L13622
Astragalus canadensis L. 2033, Milkvetch
Lathyrus ochroleucus Hook. 765, 833, White wild sweet pea
L. palustris L. 1519
L. venosus Muhl. var. *intonus* Butt. & St. John, 179, 750, Veiny sweet pea
Melilotus officinalis (L.) Lam. 473, Yellow sweet clover
Psoralea argophylla Pursh 1186, Silver Psoralea
Trifolium agrarium L. 775, Hop clover
T. hybridum L. 254, Alsike clover
T. pratense L. 398, Red Clover
T. repens L. 135, White clover
Vicia americana Muhl. 86, Common vetch
V. americana var. *truncata* (Nutt.) Brewer 1919
Geranium bicknellii Britt. 70, 376,

- Cranesbill
G. maculatum L. 1406, 1466, Spotted cranesbill
Euphorbia supina Raf. L. 15673
Polygala paucifolia Willd. 1196a, Fringed milkwort
Callitriche palustris L. 851, 953, Vernal water-starwort
Rhus glabra L. 25, 728, Smooth sumac
R. radicans L. var. *rydbergii* (Small) Rehd. 502, Poison Ivy
Ilex verticillata (L.) Gray 95, 230
Celastrus scandens L. 860, Bittersweet
Acer negundo L. 722, Box elder
A. rubrum L. 486, 859, Red maple
A. saccharinum L. 540, 1152, Soft maple
A. spicatum Lam. 467, 736, Mountain maple
Impatiens capensis Meerb. 873, 1168, Touch-me-not
Rhamnus alnifolia L'Her 181, Alder-leaved buckthorn
Parthenocissus quinquefolia (L.) Planch 3131, 453, Woodbine
Tilia americana L. 32, 92, Basswood
Hypericum boreale (Britt.) Bickn. 1150, L13665, Northern St. John's-wort
H. ellipticum Hook. 1635, Yellow St. John's-wort
H. majus (Gray) Britt. L13664, Common St. John's-wort
H. virginicum L. var. *fraseri* (Spach.) Fern. 659, 1066, Marsh St. John's-wort
Lechea intermedia Leggett 1121, Pinweed
Viola adunca J. E. Smith 840, 1027, Sand violet
V. conspersa Reichenb. 637, American dog violet
V. cucullata Ait. 660, Meadow violet
V. incognita Brainerd 225, 853, Large-leaved marsh white violet
V. novae-angliae House 646, 944, New England blue violet
V. pallens (Banks) Brainerd 864, 951, White sweet violet
V. renifolia Gray 164, 890, Kidney-leaved white violet
V. selkirkii Pursh 226, 633, Long-spurred violet
V. sororia Willd. 1920, 1253, Sister violet
Circaea alpina L. 403, 1114, Northern Enchanter's nightshade
C. canadensis Hill 1168
 Tall Enchanter's nightshade
Epilobium angustifolium L. 182, 393, Fireweed
E. glandulosum Lehm. var. *adenocaulon* (Haussk.) Fern. 476, 878, Willow-herb
E. leptophyllum Raf. 359, Marsh willow-herb
Oenothera parviflora L. 200, 426, Common evening primrose
O. perennis L. 857, 1153, Sundrops
Myriophyllum exalbesces Fern. 1043, Water-milfoil
M. farwellii Morong 548, 690, Farwell's water-milfoil
M. verticillatum L. var. *pectinatum* Wallr. L15710
Hippurus vulgaris L. 1719, Mare's-tail
Aralia hispida Vent. 880, 1154, Bristly sarsaparilla
A. nudicaulis L. 75, 648, Sarsaparilla
A. racemosa L. 481, 1002, Spikenard
Carum carvi L. 684, Caraway
Cicuta bulbifera L. 565, 989, Bulblet hemlock
C. maculata L. 373, 852, Spotted hemlock
Heracleum maximum Bartr. 770, Cow-parsnip
Osmorhiza claytoni (Michx.) C. B. Clarke 784, Sweet Cicely
Sanicula marilandica L. 1261, Sanicle
Sium suave Walt. 745, 955, Water parsnip
Zizia aptera (A. Gray) Fern. 1188, Heart-leaved Alexanders
Z. aurea (L.) W. D. J. Koch 154, 1008, Golden Alexanders
Cornus alternifolia L. f. 29, Alternate-leaved dogwood
C. baileyi Coulter & Evens 327, 720, Bailey's dogwood
C. canadensis L. 888, 1039, Bunch berry
C. canadensis f. *florulenta* Lak. 223, Many-flowered bunch berry
C. canadensis f. *ramosa* Lepage 222, 599, Branching bunch berry
C. rugosa Lam. 1106, 1165, Round-leaved dogwood
C. stolonifera Michx. 352, Red-osier
Chimaphila umbellata (L.) Nutt. var. *cisatlantica* Blake 827, 1139, Pipsissiwa
Moneses uniflora (L.) Gray 264, 1143, One-flowered pyrola
Monotropa uniflora L. 904, 1141, Indian pipe
Pyrola asarifolia Michx. 177, Shinleaf
P. elliptica Nutt. 1136, 1147, Common Pyrola
P. secunda L. 416, 1142, One-sided Pyrola
P. virens Schweigg. 50, 1137, Green Pyrola
Andromeda glaucophylla Link. 369, Bog Rosemary
Arctostaphylos uva-ursi (L.) Spreng. 65, Bearberry

- A. uva-ursi* var. *adenotricha* Fern. & MacBride
Chamaedaphne calyculata (L.) Moench.
 var. *angustifolia* (Ait.) Rehder 59, 645,
 Leatherleaf
Epigaea repens L. 1654, Trailing arbutus
Gaultheria hispida (L.) Bigel 90, 908,
 Snowberry
G. procumbens L. 621, 1085, Wintergreen
Kalmia polifolia Wang. 661, Bog laurel
Ledum groenlandicum Oeder 813, 881,
 Labrador Tea
Vaccinium angustifolium Ait. 642, 1251,
 Blueberry
V. macrocarpon Ait. 927, 1156, Large-
 fruited cranberry
V. myrtilloides Michx. 68, Lowland blue-
 berry
V. oxycoccus L. 812, Small fruited cran-
 berry
Lysimachia ciliata L. 766, 1118, Fringed
 loosestrife
L. terrestris (L.) BSP. 976, 1138, Com-
 mon loosestrife
L. thyriflora L. 400, 422, Tufted loose-
 strife
Trientalis borealis Raf. 892, 1034, Star-
 flower
T. borealis f. *pluriverticillata* Marie Vic-
 torin & Rolland, 628, Whorled star-
 flower
Fraxinus nigra Marsh. 15, 451, Black ash
F. pennsylvanica Marsh. 474, 1128, Red
 ash
F. pennsylvanica Marsh. var. *subinteger-
 rima* (Vahl.) Fern. 470, 1124, Green
 ash
Halenia deflexa (Sm.) Griseb. 1009,
 Spurred gentian
Menyanthes trifoliata L. var. *minor* Raf.
 846, Buckbean
Apocynum androsaemifolium L. 127,
 670, Dogbane
Asclepias incarnata L. 431, Swamp milk-
 weed
Convolvulus spithameus L. 1189, Dwarf
 bindweed
Cuscuta gronovii Willd. L13610, Dodder
Cynoglossum boreale Fern. 109, Hound's
 tongue
Hackelia americana (A. Gray) Fern. 406,
 Nodding stickseed
Lithospermum canescens (Michx.) Lehm.
 1626, Hoary Puccoon
Mertensia paniculata (Ait.) G. Don 665,
 Tall lungwort
Myosotis scorpioides L. 1004, Forget-me-
 not
Dracocephalum parviflorum Nutt. 184,
 717, Dragonhead
Galeopsis tetrahit L. 745, 1169, Hemp
 nettle
Lycopus americanus Muhl. 258, American
 Horehound
L. uniflorus Michx. 597, 1125, Northern
 bugle weed
Mentha arvensis L. 514, 598, Sweet mint
M. arvensis var. *glabrata* (Benth.) R. S.
 Stewart 521, 810, Smooth sweet mint
Prunella vulgaris L. 120, 337, Selfheal
Scutellaria epilobiifolia A. Hamilt. 239,
 965, Marsh skullcap
S. lateriflora L. 378, 520, Mad-dog skull-
 cap
Stachys palustris L. 1014, Woundwort
S. palustris var. *homotricha* Fern. 362,
 215, Hairy woundwort
Chamaesaracha grandiflora (Hook.) Fern.
 414, 567, Large-flowered ground cherry
Melampyrum lineare Lam. 919, 1148,
 Cow wheat
Mimulus ringens L. 286, 985, Monkey
 flower
Scrophularia lanceolata Pursh 170, 1007,
 Figwort
Veronica scutellata L. 1146, Speedwell
Veronicastrum virginicum (L.) Farw.
 1006, Culver's physic
Utricularia intermedia Hayne 622,
 Smaller bladderwort
U. vulgaris L. 830, 1195, Common
 bladderwort
Plantago major L. 409, Common plantain
Galium asprellum Michx. 1353, Rough
 bedstraw
G. boreale L. 199, 768, Northern bed-
 straw
G. tinctorium L. 289, Marsh bedstraw
G. trifidum L. 1711, Slender bedstraw
G. triflorum Michx. 409, 1129, Sweet
 bedstraw
Diervilla lonicera Mill. 83, Bush honey-
 suckle
D. lonicera var. *hypomalaca* Fern. 324,
 Downy-leaved bush honeysuckle
Linnaea borealis L. var. *americana*
 (Forbes) Rehd. 99, 906, Twinflower
Lonicera canadensis Marsh. 55, 350,
 American Fly-honeysuckle
L. dioica L. var. *glaucescens* (Rydb.)
 Butters 335, 387, Climbing honeysuckle
L. hirsuta Eat. 283, 405, Hairy climbing
 honeysuckle
L. villosa (Michx.) var. *solonis* (Eaton)
 Fern. 1508
Sambucus pubens Michx. 673, 11, 503,
 Elderberry
Symphoricarpos albus (L.) Blake 332,
 Snowberry
Viburnum rafinesquianum Schult. 96, 493,
 Arrow-weed
V. rafinesquianum var. *affine* (Bush)

- House 34, 718, Downy arrow-wood
V. trilobum Marsh. 463, 629, Highbush
 cranberry
Campanula aparinoides Pursh 238, Marsh-
 bellflower
C. rotundifolia L. var. *intercedens* (Wit-
 aseki) Farw. 341, 988, Harebell
C. uliginosa Rydb. 436, 458, Swamp blue-
 bell
Lobelia dortmanna L. 916, Water Lobelia
L. spicata Lam. 1863, Pale Lobelia
Achillea lanulosa Nutt. 142, Woolly
 Yarrow
Ambrosia pilostachya DC. var. *coronopi-
 folia* (T. & G. Fern. L15736, Perennial
 ragweed
Ambrosia trifida L. 727, Tall ragweed
Anaphalis margaritacea (L.) C. B. Clarke
 var. *intercedens* Hara 614, 884, Pearly
 Everlasting
Antennaria canadensis Greene 309, 1133,
 Pussy-toes
A. munda Fern. 759, 1140, Trim ever-
 lasting
Arctium minus (Hill) Bernh. 515, Bur-
 dock
Artemisia absinthium L. 161, Wormwood
Aster ciliolatus Lindl. 832, 1100, Blue
 northern aster
A. junciformis Rydb. 1181, Bog aster
A. lateriflorus (L.) Britt. 500, 1247,
 Calico aster
A. macrophyllus L. 84, 462, Large-leaved
 northern aster
A. puniceus L. 508, 877, Swamp aster
A. ptarmicoides (Nees) T. & G. 2019,
 Ptarmigan aster
A. simplex Willd. 624, 539, Common
 white aster
A. simplex var. *interior* (Wieg.) Cronq.
 L15684a
A. simplex var. *ramosissimus* (T. & G.)
 Conq. L15716
A. umbellatus Mill. var. *pubens* Gray
 593, Flat-topped white aster
Bidens cernua L. 588, Nodding bur
 marigold
B. frondosa L. 607, Beggar ticks
Chrysanthemum leucanthemum L. var.
pinnatifidum Lecoq & Lamotte 123,
 870, Oxeye daisy
Cirsium arvense (L.) Sep. 410, Canada
 thistle
C. muticum Michx. 192, 494, Swamp
 thistle
C. vulgare (Savi) Tenore L13653a, Bull
 thistle
Crepis runcinata (James) T. & G. June
 28, '52 Ahlgren, Hawk's beard
Erigeron canadensis L. 602, Horse weed
E. philadelphicus L. 773, Fleabane
E. strigosus Muhl. 333, 782, Rough flea-
 bane
Eupatorium maculatum L. 510, Joe-Pye
 weed
Gnaphalium macounii Greene 614, Sweet
 cud weed
Helenium autumnale L. var. *canaliculatum*
 (Lam.) T. & G. 2023, Sneezeweed
Helianthus maximiliana Schrad. 1171,
 Showy sunflower
H. laetiflorus Pers. var. *rigidus* (Cass)
 Fern. 1148, Stiff sunflower
H. laetiflorus Pers. var. *subrhomboideus*
 (Rydb.) Fern. L15740, Prairie Sun-
 flower
Hieracium aurantiacum L. 789, Orange
 Hawkweed
H. canadense Michx. var. *fasciculatum*
 (Pursh) Fern. 331, 496, Common
 hawkweed
H. scabrum Michx. 1104, 1170, Rough
 hawkweed
Lactuca biennis (Moench.) Fern. 506,
 Blue lettuce
L. canadensis L. 290, Wild lettuce
Liatris pycnostachya Michx. 2017,
 Blazing star
Matricaria matricarioides (Less.) Porter
 119, 196, Chamomile
Megalodonta beckii (Torr.) Greene 546,
 996, Water bur-marigold
Petasites palmatus (Ait.) A. Gray 257,
 418, Sweet coltsfoot
P. vitifolius Greene 1069, Arrow-leaved
 coltsfoot
Prenanthes alba L. 852, Rattlesnake root
Rudbeckia serotina Nutt. 1013, Brown-
 eyed Susan
Senecio pauperculus Michx. var. *bal-
 samitae* (Muhl.) Fern. 253, 769,
 Golden ragwort
Solidago canadensis L. 589, Canada
 goldenrod
S. gigantea Ait. L13898
S. gigantea var. *leiophylla* Fern. 1022,
 Tall goldenrod
S. graminifolia (L.) Salisb. 619
S. hispida Muhl. 1107, 1115, Hispid
 goldenrod
S. juncea Ait. 345, Slender goldenrod
S. missouriensis Nutt. var. *fasciculata*
 Fern. 501, Early goldenrod
S. nemoralis Ait. 1230, Pasture goldenrod
S. uliginosa Nutt. 1070, Swamp golden-
 rod
S. rigida L. L15733, Stiff Goldenrod
Sonchus arvensis L. 477, Sow thistle
S. asper (L.) Hill, L15702, Rough sow
 thistle

Taraxacum officinale Weber var. *palustre*
(Sm.) Blytt. 79, Common dandelion

Tragopogon major Jacq. 767, Goat's-
beard

ADDENDUM

The appended list was compiled from additional collections made during the summer of 1953.

Sparganium americanum Nutt. L16474,
Nuttall's bur-reed

Alisma triviale Pursh L16318, Large-
flowered water plantain

Calamagrostis inexpansa Gray L16419,
Bog reed grass

Carex Backii Boott L16472, Back's sedge

C. comosa Boott L16472, Bristly sedge

C. deflexa Hornem. L13986, Bent sedge

C. pseudo-cyperus L. L16505, Cyperus
sedge

C. scoparia Schkuhr f. *condensa* (Fern.)
Kuckenth. L. 16458, Broom sedge

C. viridula Michx. L16424, Green sedge

Heteranthera dubia (Jacq.) MacM.

L16487, Water star-grass

Cypripedium acaule Ait. L16311 Moccasin
flower

Habenaria orbiculata (Pursh) Torr.

L16378, Round-leaved rein orchid

Shepherdia canadensis (L.) Nutt.

L16349, Canadian buffalo-berry

Circaea quadrisulcata (Maxim.) Franch.

& Sav. var. *canadensis* (L.) Hara

L16499

Pyrola rotundifolia L. var. *americana*

(Sweet) Fern. L16372, Round-leaved
pyrola

P. secunda L. var. *obtusata* Turcz.

L16377, Lesser one-sided pyrola

Monarda fistulosa L. var. *mollis* (L.)

Benth. L16358, Wild bergamot

Viburnum lentago L. 2326, Black haw

Erigeron annuus L. L16352, Annual

fleabane

Rudbeckia laciniata L. L16354,

Goldenglow

Notes on Wisconsin Parasitic Fungi. XIX.

H. C. Greene

Department of Botany, University of Wisconsin, Madison

The collections on which this series of notes is based were, unless stated otherwise, made during the season of 1952.

Powdery mildews, undetermined as to species, have been observed on the following hosts, upon which such fungi have not been previously recorded as occurring in Wisconsin: *Solidago flexicaulis* (latifolia), Columbia Co., Gibraltar Bluff near Okee, September 23, 1951; *Potentilla norvegica* var. *hirsuta*, Dane Co. near Sauk City, September 5; *Asclepias syriaca*, Dane Co., Madison September 8; *Asclepias phytolaccoides*, Dane Co., Madison, September 19; *Chrysanthemum parthenium*, Dane Co., Madison, July 19.

PUCCINIA ELLISIANA Thüm. It was reported by J. J. Davis as having occurred on *Viola pedata* at Racine in 1903, but there is no specimen at the University of Wisconsin. The rust was present on this host in abundance in June 1952 at Gibraltar Bluff in Columbia Co. *P. ellisiana* is obviously closely linked with Wisconsin's vanishing prairie flora and seems to turn up only on the few relatively large and undisturbed prairie remnants now left in the state.

PHYLLOSTICTA sp. was collected on leaves of *Ranunculus pennsylvanicus* at Madison, July 3, and the lesions produced by it are so similar to those formed on *Ranunculus rhomboides* by *Septoria polaris* Karst. as to have been mistaken for the latter in the field. The ashen brown spots are more or less angled, the black, globose pycnidia are 100-135 μ diam. The conidia are hyaline and rod-shaped, very numerous in the pycnidium, about $4.6 \times 1.5 \mu$.

PHYLLOSTICTA ABORTIVA Ell. & Kell. was described (Jour. Mycol. 1: 4. 1885) as occurring on large and distinctive lesions on leaves of *Menispermum canadense*, and as having the spores imperfectly developed. The collection was made at Manhattan, Kans., in November. Tehon and Daniels (Mycologia 19: 119. 1927) re-examined the type specimen and found that some of the pycnidia contained scolecospores, so they assigned the fungus to *Septoria* and published an emended description. In October 1926 at Blue River, Grant Co., J. J. Davis collected a fungus on the same host, with lesions corresponding closely with those of *Septoria abortiva*. Most of the small pycnidia of this specimen are likewise sterile, but a few contain hyaline microconidia, rod-shaped, about $4 \times 1 \mu$. None that were examined bore scolecospores. It is assumed that the Wisconsin fungus, a late season development as was the type specimen, is the precursor of a perfect stage, perhaps a *Mycosphaerella*, which requires overwintering to complete the cycle.

PHYLLOSTICTA sp. occurred on rounded to elongate, reddish-brown areas on living leaves of *Aster oblongifolius* at Madison, August 25. The dark-brown pycnidia are subglobose, with a ring of blackish cells around the ostiole, about 125 μ diam. The conidia are hyaline, subcylindric to subfusoid, $5.7 \times 2.5-3 \mu$.

PHYLLOSTICTA on leaves of *Lactuca spicata*, collected near Potosi, Grant Co., August 16, seems close to *P. mulgedii* J. J. Davis (Trans. Wis. Acad. Sci. 16: 761. 1910), but I find no specimen of the latter for comparison in the Wisconsin Herbarium. In the Potosi collection the epiphyllous pycnidia are mostly gregarious on small, sunken, ashen spots which, in turn, are clustered in orbicular to variously elongate brown areas, up to 3 cm. diam. The conidia are subcylindric, elliptic, or ovoid, with a greenish tinge, $4.6-5 \times 3.4 \mu$. The lesions of *P. mulgedii* are described as similar, although said to be a uniform dark brown. The conidia, however, were hyaline, $3.7 \times 3 \mu$.

PHOMA sp. occurred on living stems of an undetermined species of *Cuscuta* parasitizing nettles in a marsh at Madison, July 8. The pycnidia are subglobose, sooty-brown, about 175 μ diam., while the conidia are continuous, hyaline, guttulate, subfusoid to fusoid, $10.17 \times 3.4 \mu$. In shape, the conidia suggest *Phomopsis*, but scolecospores were not seen. There is an almost total lack of reports of parasites on dodder.

PHOMOPSIS sp. is present on dead, blackened portions of fronds of *Athyrium angustum*, collected at Madison, July 8. The pycnidia are most inconspicuous and the relationship of fungus to death of host is questionable. The scattered pycnidia are subglobose, dull yellowish brown, about 100-125 μ diam. The *Phoma*-type spores are subfusoid to fusoid, hyaline and granular, 7-13 x 2.5-4 μ . The scoleospores are hyaline, continuous, strongly curved, tapering to a sharp point at each end, 30-50 (mostly 40-50) x 1.5-2 μ .

PHOMOPSIS sp. (?) occurred on dead tips of leaf segments of *Tagetes erecta* (cult.) at Madison, September 7. The pycnidia are crowded, large, prominent, black, subglobose, up to about 300 μ diam. At the extreme, there are two types of conidia present, 1) short, stout, sublimoniform, about 6-7 x 3.5 μ , and 2) very slender fusiform, about 11-13 x 2.5 μ . There are, however, intergrades present and there is not the usual sharp differentiation between A- and B-type spores. What appears to be the same organism was also found on leaves of *Zinnia elegans* (cult.) at Madison, September 16.

DOTHIORELLA QUERCINA (C. & E.) Sacc. is listed in manuals of plant diseases as causing a twig blight of oak. A specimen from Hartland, Waukesha Co., on red oak, where it was said to be causing die-back of twigs, was seen in July 1952, but active parasitism seems uncertain. The late J. J. Davis collected a specimen on white oak at Madison, on dead, overwintered limbs.

ASCOCHYTA (?) occurs on leaves of *Corylus americana*, collected in the Town of Primrose, Dane Co., July 12, 1951. Possibly an immature *Stagonospora*. The dark brown pycnidia are epiphyllous in small groups on rather large (4-7 mm.), orbicular, dull-purple spots. The pycnidia are about 80-100 μ diam. and seem rather poorly developed below—conceivably the fungus could be assigned to the Leptostromataceae. The conidia are hyaline, cylindric, subcylindric, or subfusoid, continuous or 1-septate, 6-14 x 2.5-3.5 μ .

ASCOCHYTA sp. appears in small amount on leaves of *Aster sericeus* collected at White Lake, Langlade Co., September 1951. The large and conspicuous black pycnidia, 175-200 μ diam., are subseriate arranged on elongate pale brown spots. The conidia are mostly about 10-15 x 3 μ , with some up to 20 μ . The conspicuous, protruding pycnidia, readily visible even on the very hairy host leaves, do not admit of assigning this to *Ascochyta compositarum* J. J. Davis.

DARLUCA FILUM (Biv.) Cast. on telia of *Puccinia canaliculata* (on *Cyperus strigosus*, Madison, August 20) bears numerous hyaline microconidia, about 3 x 1 1/4 μ , in the same pycnidia with normal *Darluc* conidia.

DARLUCA FILUM (Biv.) Cast. occurred on aecia of *Puccinia caricis* on *Ribes missouriense*, near Monticello, Green Co., June 10.

SEPTORIA SIGMOIDEA Ell. & Ev. is represented in the Wisconsin Herbarium by two specimens on *Panicum virgatum*, one collected near Lynxville, Crawford Co., in 1915, the other taken recently at Madison. The spores in both have a fuliginous tint and, from their shape and thickness, I judge they would be better assigned to *Hendersonia*. The description makes no statement as to color of the spores, or lack of it. In other features the Wisconsin material closely corresponds. Sprague fails to mention *S. sigmoidea* in his *Diseases of Cereals and Grasses in North America*.

SEPTORIA sp. on *Smilacina racemosa*. Green Co., New Glarus Woods, September 4. This form, very different from the coarse *Septoria smilacinae* Ell. & Mart., occurs on an elliptic, pale tan, red-bordered spot, about 1.5 cm. long. The pale, translucent, widely ostiolate pycnidia are about 50-75 μ diam., somewhat flattened, and closely crowded. The spores are hyaline, granular, more or less curved, usually tapered more at one end than at the other, mostly 3-septate, approx. 20-30 x 2.5-3 μ .

SEPTORIA sp., collected on *Lathyrus ochroleucus* at Otsego, Columbia Co., July 26, seems not to correspond well with any of the rather numerous species described on *Lathyrus* and the closely related *Vicia*. The large, globose, thin-walled, pale brown pycnidia, 150-175 μ diam., are epiphyllous on indeterminate, sordid brown lesions. The spores are hyaline, straight or moderately curved, with blunt ends, or occasionally with one end tapered more than the other, granular and seemingly continuous, 35-55 x 2.5 μ .

LEPTOTHYRIUM sp., or a form closely related thereto, is present in profusion on grayish cankers encircling dead tips of twigs on living branches of a planted, but long-established tree of *Juniperus virginiana* in the University of Wisconsin Arboretum at Madison. The black, hemispherical or slightly elongate, radiate fruiting bodies occur subseriate on the cankers, which are located some distance back from the tip and adjacent to still living

tissue. These bodies are approx. 125-175 μ diam., and the conidia are produced on broadly bottle-shaped, almost isodiametric, hyaline cells, 3-4 μ wide, which appear to line the basal portion of the fruiting structure. The continuous, hyaline conidia are cylindric, short-cylindric or subfusoid, 4-6.5 x 2-3 μ . The taxonomic position and parasitism are uncertain.

KABATIA MIRABILIS Bubak on *Lonicera oblongifolia* was reported from Wisconsin by J. J. Davis (Trans. Wis. Acad. Sci. 30: 12. 1937). I. L. Connors has studied the two specimens in question and finds differences in spore size and placement of septa which he regards as being of varietal significance, and it is my understanding that he proposes so to treat the Wisconsin material in a forthcoming publication.

COLLETOTRICHUM sp., which seems not to be *C. helianthi* Davis, is epiphyllous and possibly parasitic on large, irregular, brown lesions on leaves of *Helianthus strumosus*, collected at Gibraltar Bluff, Columbia Co., July 30. The lesions are mostly somewhat elongate and marginal, with numerous small acervuli rather evenly dispersed over them. The conidia are quite uniformly about 20 x 3.5 μ , whereas those of *C. helianthi* are mostly over 25 μ long, and often run to 30 μ or more. The lesions in the latter species are small and very sharply delimited, which is not the case with the specimen in question.

CYLINDROSPORIUM CRESCENTUM Barth., common on wild parsnip in Wisconsin, has been transferred to *Phleospora*, as *P. crescentium* (Barth.) E. A. Riley (Mycologia 44: 213. 1952).

CYLINDROSPORIUM sp., overgrowing black knot galls on *Prunus serotina* at Madison, June 20, although no doubt saprophytic on this substratum, is of considerable interest because of its possible connection with *Cylindrosporium lutescens*, the conidial stage of *Coccomyces lutescens* Higgins, cause of the leaf "shot hole" of black cherry. The spores produced on the galls are suggestively similar in shape to those formed on leaves, but are somewhat shorter, a fact that might be due to a smaller available supply of water and nutrients.

FUSICLADIUM RADIOSUM (Lib.) Lind., on fallen leaves from mature trees of *Populus grandidentata* from Devils Lake, Sauk Co., and from near Portage, Columbia Co., collected in September, is very different in habit from all other specimens in the Wisconsin Herbarium. Most of these were taken in June and the fruiting is in the effused patches which seems to be characteristic. From practical considerations in gathering them they are also usually on juvenile leaves from low-growing shoots. The fallen leaves have extremely conspicuous orbicular gray lesions, 1-2 cm. diam., bearing on them scattered, epiphyllous, punctate fruiting aggregates, not much more than 100 μ diam. The conidia are apparently those of *F. radiosum*, and it seems likely that if leaves from mature trees were studied early in the season, this type of lesion would be found to be not uncommon.

MASTIGOSPORIUM RUBRICOSUM (Dearn. & Barth.) Nannf., causing eye-spot disease of *Calamagrostis canadensis* in Wisconsin, was reported in Davis' early lists of Wisconsin parasitic fungi as *Mastigosporium album* Riess. var. *calvum* Ell. & Davis. In later publications Davis referred to it simply as *M. album*, but it now appears that *M. rubricosum* is the name properly applied. Bollard (Trans. Brit. Mycol. Soc. 33: 250-275. 1950) has published a quite definitive study of the genus *Mastigosporium*.

CERCOSPORA MUHLENBERGIAE Atk. seems to be a dubious member of the genus. A specimen on nodes and sheath collars of *Muhlenbergia mexicana*, collected September 3 near Poynette, Columbia Co., was sent to Charles Chupp for his opinion. The conidia are very stout and nearly all are 1-septate. Chupp states that while this is plainly the fungus that was originally named *C. muhlenbergiae*, a representative *Cercospora* should have conidia that average 3 or more septa. This is another case demonstrating the lack of hard and fast lines between genera.

ALTERNARIA sp., which may well be parasitic, occurs on strikingly sharp spots on leaves of *Aster linariifolius*, collected in Sauk Co., near Spring Green, August 12. This has been noted at other stations on several earlier occasions, but not before in such profusion. The small spots are white or ashen, round, oblong, or more elongate, 1-4 mm., with a narrow, raised, yellowish-brown margin. Their width is limited to one-half of that of the narrowly linear, strongly ribbed leaf. The small tubercles from which the spreading tufts arise are situated within the stomata and there is hence a regular dispersion pattern of tufts over the spots. The phores are dark olivaceous below, paler at the tips, mostly

once or twice septate, occasionally 3-4 or more septate, usually somewhat tortuous and several times geniculate, $35-65 \times 3.5-4.5 \mu$. Although the conidia are quite small, they are of the usual *Alternaria* type, muriform, about $30-40 \mu$ in overall length, by $10-12 \mu$ wide at base. There is no evidence of insect infestation but some of the spots bear, instead of the *Alternaria*, a *Phyllosticta* discussed by me in an earlier series of notes (Amer. Midl. Nat. 48: 39. 1952), so it seems possible that the *Alternaria* is secondary on spots caused by the *Phyllosticta*, but on which pycnidia failed to develop.

FUSARIUM HETEROSPORUM Nees, so-called, produces strikingly brilliant red-orange growths on, or associated with, sclerotia of *Claviceps purpurea* (Fr.) Tul. in the inflorescences of various grasses. It has been noted occasionally in Wisconsin and Davis at one time reported it as a parasite, but seems later to have changed his mind as to its status. Exceptionally fine material occurred on quack grass at Madison in 1952.

Morus rubra at Madison, in June, on dead brown leaves of the terminal twigs bore an indeterminate fungus which, it seems possible, may be the conidial stage of a Basidiomycete. Numerous rounded, closely appressed, sordid-whitish clumps of the fungus are thickly scattered over the leaves, suggesting *Cylindrosporium*. These proved, however, to be aggregations of hyaline, ellipsoid or subfusoid spores associated with larger, rounded, thick-walled cells, and seemingly, in some cases at least, borne on the latter. The spores are frequently budded, but it does not appear that the fungus in question is a yeast or related form. Probably merely superficial and secondary, but possibly parasitic.

DOTHICHIZA sp. (?) occurred on the upper surface of lesions produced by *Phragmidium ivesiae* on *Potentilla recta* at Madison in June. Under a hand lens the fungus has the aspect of a still-covered *Gloeosporium*, but proves instead to be a pycnidial form, rather strongly erumpent when moist, but collapsing upon drying. These pycnidia lack definite ostioles, appear subcuticular, are dark brown, thin-walled, with the entire inner wall surface covered with slender, olivaceous, closely ranked conidiophores, about $15-18 \times 1.5 \mu$. The hyaline conidia are rod-shaped, mostly $4.5 \times 1.5 \mu$. In section the pycnidia are somewhat flattened, up to 200μ diam. $\times 100 \mu$ thick. Since spermatogonia are unknown for *P. ivesiae* it does not seem likely that the structures described have any direct relation with the rust.

"RHYTISMA" *SOLIDAGINIS* Schw., the black, elliptic, applanate growth which occurs commonly on the linear leaves of *Solidago graminifolia*, has been found in very characteristic development on the likewise linear leaves of *Aster linariifolius* at a station in Dane Co., near Sauk City. Although this fungus is said to be associated with and follow insect activity, I have not personally seen anything in the field to confirm the correctness of this view.

Muhlenbergia uniflora, collected in autumn in northwestern Wisconsin, and represented by a number of phanerogamic specimens in the Wisconsin Herbarium, shows, in several instances, prominent, elongate, erumpent yet deeply seated, black, sclerotium-like bodies thickly dispersed over the current season's flowering stems. Within some of these structures there are numerous rod-shaped microconidia. It seems probable that this is the parasitic precursor of a perfect stage which requires overwintering for fulfillment.

ADDITIONAL HOSTS

The following hosts have not been previously recorded as bearing the fungi mentioned in Wisconsin.

ERYSIPHE CICHORACEARUM DC. on *Aster sericeus*. Dane Co. near Sauk City, September 5.

CLAVICEPS PURPUREA (Fr.) Tul. Sclerotia on *Festuca obtusa*. Columbia Co., Gibraltar Bluff near Okee, July 30.

ACANTHOSTIGMA OCCIDENTALE (Ell. & Ev.) Sacc. Conidial stage on *Petalostemum villosum*. Dane Co., Madison, August 20. Also on *Amorpha canescens* at the same station, August 23. The first time this has been noted in Wisconsin on non-composites. Seemingly the prime requisite is a densely hairy host leaf surface. One might be inclined to question the parasitism of such a fungus were it not for the fact that it occurs on healthy green leaves which are clean and free from insect droppings.

COLEOSPORIUM VIBURNI Arth. II, III on *Viburnum lantana* (cult.). Dane Co., Madison, July 21.

- PUCCINIA STIPAE* Arth. I on *Aster laevis*. Green Co., near Albany, June 1.
- PUCCINIA HELIANTHI* Schw. II, III on *Helianthus petiolaris*. Columbia Co., near Dekorra, August 22. An eastward extension of the Manual range.
- CINTRACTIA SUBINCLUSA* (Korn.) Magn. on *Carex vesicaria*. Vilas Co., Boulder Junction, August 14, 1936. Coll. J. J. Davis.
- XENOGLLOEA ERIOPHORI* (Bres.) Syd. on *Scirpus pedicellatus*. Columbia Co., Gibraltar Bluff near Okee, July 30. On *Scirpus cyperinus* var. *pelius*. Green Co., near Albany, August 5.
- PHYLLOSTICTA ORBICULARIS* Ell. & Ev. on *Sicyos angulatus*. Dane Co., Madison, August 24.
- NEOTTIOSPORA ARENARIA* Syd. on *Carex muhlenbergii*. Columbia Co., near Lodi, July 23. Especially prominent on dead upper portions of stems still green below.
- ASCOCHYTA GRAMINICOLA* Sacc. on *Muhlenbergia schreberi*. Dane Co., Madison, August 4. Abundant on lower leaves, which were dead at the time of collection.
- ASCOCHYTA COMPOSITARUM* J. J. Davis on *Ratibida pinnata*. Dane Co., Madison, July 2. In this specimen the pycnidia are subglobose, pale brown, thin-walled, 150-175 μ diam., the 1-septate conidia 10-14 x 3.5-4 μ . Probably a composite species in more senses than one. This is one of an overlapping series which have been collected on diverse Compositae in Wisconsin.
- DARLUCA FILUM* (Biv.) Cast. on *Puccinia calthae* II on *Caltha palustris*. Dane Co., Madison, July 4. On *Puccinia andropogonis* II on *Andropogon furcatus*. Columbia Co., Portage, September 15. On *Puccinia stipae* I. Columbia Co., Black Hawk's Lookout near Prairie du Sac, May 7, 1948. The host was erroneously reported in my Notes XIII (Amer. Midl. Nat. 41: 743, 1949) as *Puccinia extensicola*. The latter still stands as a host, however, for at Madison in June 1952 *Darluca* was collected on aecia of *P. extensicola* on *Solidago altissima*. *Darluca* is of course common on uredia of this rust.
- SEPTORIA ULMARIAE* Oud. on *Filipendula ulmaria* (cult.). Dane Co., Madison, July 6.
- SELENOPHOMA DONACIS* var. *STOMATICOLA* (Baueml.) Spr. & Johns. on *Aristida tuberculosa*. Sauk Co., near Spring Green, August 12. Most of the conidia are about 14-16 x 3 μ . Also on *Aristida basiramea* at Madison, Dane Co., August 20.
- CAMAROSPORIUM ROUMEGUEREI* Sacc. on *Kochia scoparia*. Dane Co., Madison, July 18.
- PHLEOSPORA ACERIS* (Lib.) Sacc. on *Acer saccharum*. Dane Co., Madison, September 3.
- COLLETOTRICHUM GRAMINICOLA* (Ces.) Wils. on *Festuca ovina*. Dane Co., Madison, July 19.
- BOTRYTIS CINEREA* Pers. on *Euphorbia marginata*. Dane Co., Madison, August 4. Appearing definitely and strongly parasitic on sharply delimited, rounded, grayish, subzonate, sunken spots.
- CLADOSPORIUM ASTERICOLA* J. J. Davis on *Aster azureus*. Dane Co., near Sauk City, September 5.
- CERCOSPORELLA SCIRPINA* J. J. Davis on *Scirpus cyperinus* var. *pelius*. Green Co., near Albany, August 5.
- CERCOSPORELLA ELEOCHARIDIS* J. J. Davis on *Eleocharis elliptica*. Dane Co., Madison, July 9. On *Eleocharis compressa*, also at Madison, July 16. On this latter host the spores are quite robust.
- CERCOSPORELLA JUNCUS* J. J. Davis on *Juncus dudleyi*. Dane Co., Madison, July 9. Restricted to the narrow-acuminate perianth "leaves."
- CERCOSPORELLA BETICOLA* Sacc. on *Kochia scoparia*. Dane Co., Madison, July 18.
- CERCOSPORELLA ALTHAEINA* Sacc. on *Napaea dioica*. Iowa Co., near Arena, September 17.
- CERCOSPORELLA LECHEAE* Chupp & Greene on *Lechea tenuifolia*. Dane Co., Paoli, August 9.
- CERCOSPORELLA OMPHACODES* Ell. & Holw. on *Phlox paniculata*. Iowa Co., along

County Trunk C, 3 mi. southeast of Lone Rock, August 12.

TUBERCULINA PERSICINA (Ditm.) Sacc. on *Puccinia cavis* I on *Ribes missouriense*. Green Co., near Monticello, June 10. On *Uromyces halstedii* I on *Trillium grandiflorum*. Clark Co., Worden Twp., June 29. Coll. M. S. Bergseng.

STILBUM TOMENTOSUM Schrad. ex Fr. on *Hemitrichia clavata*. Dane Co., Madison, September 24. Coll. R. Tinline.

ADDITIONAL SPECIES

The fungi mentioned have not been previously reported as occurring in Wisconsin.

MAZZANTIA GALII (Fr.) Mont. on *Galium boreale*. Dane Co., Madison, August 21. Immature, but a highly distinctive species which compares exactly with Rabenhorst's European specimens. The Wisconsin collection appears definitely parasitic on dead branches of otherwise still living plants. That the branches should be completely killed back is not surprising when one observes the thickly studded, deep-seated erumpent stromata.

LEPTOSPHERIA ELYMI Atk. on *Elymus villosus*. Columbia Co., near Poynette, August 5. Well matured, and appearing strongly parasitic on the pallid, elongate lesions.

Phyllosticta sorbariae sp. nov.

Maculis pallidis, marginibus angustis, fusco-brunneis, tenuibus, pellucidis, orbicularibus vel elongatis, 2-3 mm. diam. plerumque; pycnidii pallido-brunneis, muris tenuibus, subglobosis vel planis nonnihil, gregariis, 75-200 μ diam., plerumque 100-150 μ ca.; conidia hyalinis, cylindraceis, subcylindraceis, vel subfusoides, 4.7 x 3-3.5 μ .

Spots pallid, with narrow dark brown border, thin, translucent, orbicular to somewhat elongate, mostly 2-3 mm. diam.; pycnidia pale brown, thin-walled, subglobose or somewhat flattened, gregarious, 75-200 μ diam., mostly about 100-150 μ ; conidia hyaline, cylindric to subcylindric or subfusoid, 4.7 x 3-3.5 μ .

On *Sorbaria sorbifolia*. (On living leaves). Ferry Bluff, Town of Prairie du Sac, Sauk County, Wisconsin, U. S. A., July 11, 1952.

The spots are comparatively few, usually only on one or two leaflets per leaf. However, many leaves were infected. When elongate the spots are up to 5 x 2 mm. Because of the extreme thinness of the affected tissue the pycnidia protrude rather noticeably in the fresh material. I have not found reports of any fungi on *Sorbaria*.

Phyllosticta numerospora sp. nov.

Maculis nullis, foliis morbidis constanter flavis vel suffuscis; pycnidiiis gregariis epiphyllis, fuscis, planis infra, magnis, 180-230 μ diam.; conidiophoris confertis, brevibus, tenuibus, 4 x 2 μ ca.; conidia hyalinis, cylindraceis, numerosissimis, 4-6 x 1.5-2 μ .

Spots none, infected leaves uniformly straw-colored or brownish; pycnidia gregarious, epiphyllous, dark brown, flattened at base, large, 180-230 μ diam.; conidiophores closely packed, short, slender, about 4 x 2 μ ; conidia hyaline, cylindric, very numerous, 4-6 x 1.5-2 μ .

On dead leaves of still living plants of *Potentilla argentea*. Madison, Dane County, Wisconsin, U. S. A., August 25, 1952.

This species has the aspect of a virulent parasite, with the infected leaves being killed by the time the pycnidia are produced. It is significant that none of the usual saprophytes are yet present, indicating very recent killing. Conidia are produced in vast numbers, the excess being frequently exuded in droplets almost the size of the pycnidium itself. A ring of somewhat darker cells delimits the wide ostiole.

PHYLLOSTICTA CIRCUMSCISSA Cooke on *Prunus americana*. Dane Co., Madison, August 14.

Phomopsis hieracii sp. nov.

Maculis zonatis vel subzonatis, brunneis cinereisque, magnis, immarginatis, orbicularibus vel elongatis varie; pycnidiiis sparsis vel gregariis, nigris, muris crassis, non-ostiolatis, subglobosis vel planis aliquantum, 115-175 μ diam.; conidiophoris tenuibus, confertis, 10-12 μ longis; Phoma-conidiis hyalinis, fusoides vel subfusoides, 8-17 x 2.5-3.5 μ ; scolecosporis hyalinis, acicularibus, continuis, 17-30 x 1-1.5 μ .

Spots zonate or subzonate, brown with ashen markings, large, immarginate, variously

orbicular or elongate; pycnidia scattered or gregarious, black, thick-walled, non-ostiolate, subglobose or somewhat flattened, 115-175 μ diam.; conidiophores slender, crowded, about 10-12 μ long; Phoma-type conidia hyaline, fusoid or subfusoid, 8-17 x 2.5-3.5 μ ; scoleospores hyaline, acicular, continuous, 17-30 x 1-1.5 μ .

On living leaves of *Hieracium longipilum*. Madison, Dane County, Wisconsin, U. S. A., July 15, 1952.

In many cases entire leaves had been killed back by this aggressive parasite. Many plants in a large area were infected. The tissue in the spots is very thin and the large, non-ostiolate pycnidia are plainly visible on both sides of the leaf. Frequently the pycnidial walls impinging on the leaf surfaces seem fused with the leaf tissue, and thus appear thicker than the side walls. Most of the pycnidia occur in the ashen areas, but are not confined to them.

STAGONOSPORA STRICTAE Ell. & Ev. on *Carex stricta*. Dane Co., Madison, July 4. This specimen corresponds closely with the description. Contrary to the usual situation with *Stagonospora* on *Carex*, the spots are very sharply defined on the living green leaves. They are pale tan, somewhat elongate, about 2-4 mm., with narrow, dark brown, wavy margins, usually running from one edge to the other of these very narrow leaves. The North American Fungi specimen was collected in January on dead leaves, but since the spots are well marked it seems safe to assume they developed on the green leaves.

Septoria lamii Pass. var. *brevior* var. nov.

Sporulis 15-30 x 1.5-2 μ . On *Leonurus cardiaca*. Madison, Dane County, Wisconsin, U. S. A., August 7, 1952.

The spores of var. *brevior* are much shorter at their extreme than are those of any of the European specimens of *S. lamii* at their extreme. However, in view of the similar lesions and close host relationship, no more than varietal difference is indicated.

Septoria achilleae sp. nov.

Maculis fuscis, indistinctis; pycnidiis epiphyllis, gregariis, erumpentibus, piriformibus, pseudoparenchymaticis, fumosis infra, fuscis supra, 65-75 x 55-65 μ ; sporulis prope rectis vel curvis leniter vel sublunatis, hyalinis, 23-36 x 3-3.5 μ , 3-5-septatis.

Spots dark brown, indistinctly delimited; pycnidia epiphyllous, gregarious, erumpent, pyriform, pseudoparenchymatous, sooty below, darker above, 65-75 x 55-65 μ ; spores almost straight or moderately curved to sublunate, hyaline, 23-36 x 3-3.5 μ , 3-5-septate.

On living leaves of *Achillea millefolium*. Madison, Dane County, Wisconsin, U. S. A., August 10, 1952.

Although erumpent, the pycnidia are deeply seated in the palisade tissue of the host. There is a wide ring of darker cells, involving the upper third or quarter of the pycnidium, around the ostiole. Since the individual leaf segments are so very narrow and hairy, distinct spots are not present, the affected portions having been killed back. Two species of *Rhabdospora* are reported on stems of *Achillea millefolium*, but neither approximates this organism in microscopic dimensions. I have found no report of *Septoria* on any species of *Achillea*.

Colletotrichum urticae sp. nov.

Maculis cinereis, marginibus angustis, purpureis, circulis, sparsis, parvis, 1-2.5 mm. diam.; acervulis parvis, 50-65 μ diam. ca.; epiphyllis; setis tenuibus, sinuosis, sparsis, solis vel in paribus, clavo-brunneis, continuis, apicibus obtusis, 45-70 x 4-4.5 μ ; conidiophoris brevibus, tenuibus, prope obsoletis; conidiis rectis, fusoides vel subfusoides, hyalinis, 17-20 x 4-5 μ .

Spots cinereous with a narrow purplish margin, rounded, scattered, small, 1-2.5 mm. diam., acervuli small, approx. 50-65 μ diam., epiphyllous; setae slender, sinuous, scattered, single or in pairs, clear brown, continuous, apex obtuse, 45-70 x 4-4.5 μ ; conidiophores short, slender, almost obsolete; conidia straight, fusoid or subfusoid, hyaline, 17-20 x 4-5 μ .

On living leaves of *Urtica gracilis*. Madison, Dane County, Wisconsin, U. S. A., July 1, 1952.

A clean-cut, although very delicate form. The large conidia are unusual for a species of *Colletotrichum* in being quite, or almost, without curvature. I have found no report of any species of *Colletotrichum* parasitic on any of the Urticaceae which occur in the northern U. S.

OVULARIA SPHAEROIDEA Sacc. on *Vicia caroliniana*. Sauk Co., Devils Lake, September 10. European specimens in the Wisconsin Herbarium, distributed as *Ovularia schwarzi* P. Magn. are the same as other specimens distributed as *O. sphaeroidea* Sacc. and, since the latter is much the earlier name it must be used. *O. sphaeroidea* is a very striking and distinctive species which, as Salmon (Jour. Bot. 43: 41. 1905) has pointed out, has nothing to do with the so-called *Ovularia fallax* (Bon.) Sacc. which seems to have been based on the conidial stage of *Erysiphe polygoni*.

Cladosporium monardae sp. nov.

Maculis nullis, fructificationibus amphigenis, hypophyllis plerumque; fasciis ex stromatibus; stromatibus subglobosis vel planis leviter, pseudoparenchymaticis, nigricantibus, parvis, 20-35 μ diam.; fasciis numerosis, 2-3 conidiophoris divergentibus plerumque, conidiophoris fuscis, muris crassis, variis, rectis simplicibusque fere vel tortis et x-geniculatis, fortiter et prope 5-11-septatis, 75-125 x 4.5-5.5 μ ; conidiis subcylindraceis, subfusoides, vel fusoides, levibus, olivaceis, catenulatis, uniseptatis vel continuis, 10-15 x 3.5-4.5 μ .

Spots none, fruiting amphigenous, but mostly hypophyllous; tufts of conidiophores arising from small, subglobose or slightly flattened, pseudoparenchymatous, blackish stromata, 20-35 μ diam.; tufts numerous, usually with only two to three loosely diverging conidiophores; conidiophores dark brown, thick-walled, variable, from almost straight and simple to tortuous and several times geniculate, strongly and closely 5-11-septate, 75-125 x 4.5-5.5 μ conidia subcylindric, subfusoid, or occasionally fusoid, smooth, olivaceous, catenulate, uniseptate or continuous, 10-15 x 3.5-4.5 μ .

On living leaves of *Monarda punctata*. Madison, Dane County, Wisconsin, U. S. A., August 10, 1952.

A well-marked form, what with the numerous tiny stromata, many of which are connected by more or less superficial hyphae. Occasional conidiophores arise individually from these decumbent hyphae, but the great majority are in tufts. Conidiophore septation is very noticeable and in some phores the individual cells are almost isodiametric. I find no report of any parasitic species of *Cladosporium* on any labiate.

CERCOSPORA PASPALI Ray on *Paspalum stramineum*. Grant Co., Nelson Dewey Memorial Park near Cassville, August 16.

Cercospora cypericola Chupp & Greene sp. nov.

Maculis irregularibus, parvis vel magnis elongatisque, fusco-ferruginibus, marginibus distinctis raro; hypophyllis plerumque; stromatibus nullis vel paucis brunneis cellis intrastomatibus; fasciis 3-15 conidiophoris divergentibus pallidis vel mediis olivaceo-brunneis, apicibus leviter pallidioribus angustioribusque, 0.5-septatis, 0.3-geniculatis, non ramosis, caticricibus parvis ad apices conicos obtusos, 4.5-5 x 20-85 μ ; conidiis hyalinis, obclavatis, curvis plerumque, indistincte multiseptatis, basibus obconicis, apicibus acutis, 2.3-5 x 30-120 μ .

Spots irregular, minute flecks to large and elongate areas, dark reddish-brown, rarely with distinct margin; fruiting chiefly hypophyllous; stromata none, or a few brown cells filling stomatal openings; fascicles of 3-15 divergent conidiophores, pale to medium olivaceous-brown, slightly paler and more narrow toward the tip, 0.5-septate, 0.3-geniculate, not branched, small spore scar at the dull conic tip, 4.5-5 x 20-85 μ ; conidia hyaline, obclavate, mostly curved, indistinctly multiseptate, base obconic, tip acute, 2.3-5 x 30-120 μ .

On living leaves of *Cyperus strigosus*. Madison, Dane County, Wisconsin, U. S. A., August 11, 1952.

Earlier collections from Dane, Iowa, and Dunn counties by the late J. J. Davis on *Cyperus filiculmis* var. *macilentus* and on *C. Schweinitzii* (labeled as *C. caricina* Ell. & Dearn.) have likewise been determined as *C. cypericola*.

C. cypericola differs from *C. caricis* Oud. (*C. caricina* Ell. & Dearn.) in having distinctly longer, darker colored conidiophores, the conidia more curved, and with a plainly obconic base. The other species on *Cyperus*, *C. cyperi* Sawada and *C. ugandensis* Hansford, have wide conidia.

CERCOSPORA PULCHERRIMAE Tharp on *Euphorbia marginata*. Dane Co., Madison, August 4. The small specimen was sent in entirety to Chas. Chupp for determination, and a label has been placed in the Wisconsin Herbarium in lieu of a specimen.

CERCOSPORA EUPHORBIAE Kell. & Sw. on *Euphorbia corollata*. Dane Co., Black Earth, August 12. Det. Chas. Chupp.

Notes and Discussion

New Southern Illinois Plant Records

The following list of plants represents significant additions to the known flora of southern Illinois. The first four records constitute additions to the known flora of Illinois while the others are of importance because they are extensions of known range, or are additional records of the rare occurrence of the species. Ranges and previous records are based primarily on the second edition of *Flora of Illinois* (G. N. Jones, 1950). All plants were collected by the authors and are deposited at Southern Illinois University.

PLANTS NOT PREVIOUSLY REPORTED FROM ILLINOIS

Glyceria pallida (Torr.) Trin.—Swamp near spring, Wolf Lake "Scatters," northwest Union Co., June 27, 1951, 1500.

Carex decomposita Muhl.—On logs and side of trees in water, Wolf Lake "Scatters," northwest Union Co., June 27, 1951, 1499.

Rhynchospora glomerata (L.) Vahl—Sandy soil along creek, Belle Smith Springs, Pope Co., Aug. 23, 1951, 1769.

Nuphar microphyllum (Pers.) Fern.—Shallow water, Wolf Lake "Scatters," northwest Union Co., Aug. 13, 1951, 1855. Only one colony found and no flowers or fruits were observed.

ADDITIONAL LOCALITY RECORDS

Panicum implicatum Scribn.—Drainage ditch, near Sparta, Randolph Co., June 25, 1951, 1453.

Carex virescens Muhl.—Wooded valley near bluff, Belle Smith Springs, Pope Co., June 26, 1951, 1648.

Cyperus rivularis Kunth—Sandy beach, Lake Glendale, Pope Co., June 14, 1951, 1575.

Wolffia papulifera Thompson—Wolf Lake "Scatters," Union Co., Aug. 8, 1951, 1890.

Juncus secundus Beauv.—Sand deposit along stream, dry most of year, Belle Smith Springs, Pope Co., July 15, 1951, 1563; Open weedy hilltop, inside old Indian fort, near Stonefort, Saline Co., July 26, 1951, 1661. Listed as occurring in Illinois by Deam (1940) but not included in this state by Jones (1950) or Fernald (1950).

Monotropa lanuginosa Michx.—Oak-hickory hilltop, west of Murphysboro, Jackson Co., July 4, 1951, 1509.

Erucastrum gallicum (Willd.) O. E. Schulz—Railroad ballast, north of Pomona, Jackson Co., July 5, 1951, 1515.

Saxifraga forbesii Vasey—Moist sandstone bluff, The Pounds, south Gallatin Co., May 14, 1951, 1352.—Julius R. Swayne and Wm. M. Bailey, Southern Illinois University, Carbondale.

REFERENCES

- DEAM, C. C. 1940—*Flora of Indiana*. Indianapolis.
FERNALD, M. L. 1950—*Gray's Manual of Botany* (ed. 8). American Book Co.
HITCHCOCK, A. S. 1950—*Manual of the Grasses of the United States* (ed. 2, revised by Agnes Chase). Washington.
JONES, G. N. 1950—*Flora of Illinois* (ed. 2) Amer. Midl. Nat. Monogr. 5. University of Notre Dame.

Notes on *Aquilegia**

Except when stated otherwise, all specimens cited below are preserved in the herbarium of the Division of Botany and Plant Pathology, Department of Agriculture, Ottawa (DAO).

* Contribution No. 1208, Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Ontario.

AQUILEGIA BREVISTYLA Hooker; *A. canadensis* L. var. *hybrida* Hooker, Fl. Bor. Am. 1:24. 1829.

The type of Hooker's variety (at Kew) is a characteristic specimen of *A. brevistyla* Hooker. The plant heretofore called *A. canadensis* L. var. *hybrida* Hooker must then become:

AQUILEGIA CANADENSIS L. var. *eminens* (Greene) stat. n.; *Aquilegia eminens* Greene, Rep. Sp. N. 13:320. 1914; *A. canadensis* L. var. *hybrida* AA. nec Hooker.

The type of Hooker's variety comes from the Rocky Mountains, about 700 miles west of the nearest known locality of var. *eminens*. Furthermore the type of var. *hybrida* Hooker is a characteristic specimen of *A. brevistyla* Hooker.

AQUILEGIA CHRYSANTHA Gray var. *RYDBERGII* Munz f. *pleiocalcarata* f. n. Laminis, calcaribus sepalisque 6-10 in flore. Type: F. Fyles, test plots, Horticultural Division, Central Experimental Farm, Ottawa, July 4, 1928.

AQUILEGIA FORMOSA Fischer var. *communis* var. n. Sepala cardinalia 12-22 mm long., 5-8 mm lat.

BRITISH COLUMBIA: Gillett & Mitchell 3661, Bennett, railway embankment, abundant, flowers scarlet, stamens and corollas yellow, July 11, 1949 (type); D. A. Mitchell 176, Bennett, clearings along railway, abundant, July 13, 1949; E. W. Tisdale 40-400, Kamloops, Tranquille Range, upper montane forest, 3200', June 26, 1935; E. W. Tisdale 40-401, Blue Lake near Lytton, alpine zone on gravel slide, 7000', Aug. 5, 1938; (J. M. Macoun?) Agassiz; W. Newton, Sooke River, pothole, July 16, 1939; H. Groh, Ruskin, May 16, 1931; Fletcher & Anderson, Mt. Cheam, 15 Aug., 1901; J. R. Anderson, Victoria, woods; G. R. Sawes, Enderby, July, 1898; C. W. Lowe, Nanaimo, June, 1931; M. C. Dudley 187, Cameron L., Vancouver Is., June 15, 1940.

WASHINGTON: W. J. Eyerdam 1454, Mt. Pugh, Snohomish Co., 2000 m. elev., July 14, 1935.

AQUILEGIA FORMOSA Fischer var. *megalantha* var. n. Sepala cardinalia 22-28 mm long., 8-11 mm lat.

BRITISH COLUMBIA: J. M. Macoun 69384, first summit w. of Skagit River, by a brook, alt. 4000 ft., July 18, 1905 (type).

ALASKA: J. P. Anderson 6259, Juneau, rocky hillside, June 18, 1940; W. J. Eyerdam 7321, Port San Juan, Evans Island, on creek bank, July 25, 1948.—BERNARD BOIVAN, Department of Agriculture, Ottawa, Canada.

A New Form of *Gentiana Romanzovii*

On September 7, 1951, an unusual form of *Gentiana Romanzovii* Ledeb. was collected in the tundra of Larimer County west of Estes Park, Colorado, along Trailridge Road at 12,000 feet. This plant predominated as large mats in palustro-seres and along drainage lines.

The collected material, when compared with herbarium specimens of *Gentiana Romanzovii*, varied in that the flower of most had 6-lobed accessory whorls and 1 androecium of 6 stamens. All other floral characters including the pattern of fine blue lines and dots in the citreous corolla were typical. There were no vegetative differences. Thus undoubtedly this form represents a very singular mutation; however, it may be noteworthy since the literature on the genus shows only a variation in number of floral parts of 4-5. In rare instances plants were found which were 4-merous. This variation is not described for the species.*

Gentiana Romanzovii Ledeb. forma *hexaloba* forma nov. (Fig. 1) periandrom atque androecium sexpartitum; notae ceterae constantes.

Plant with 6-merous flowers except for gynoecium; this form differs from the typical *G. Romanzovii* only in this one floral variation, one not typical of the genus.—Marshy tundra west of Estes Park, Larimer County, Colorado, along Trailridge Road at 12,000 feet, September 7, 1952 (Type in Harris Herbarium, North Texas State College).—ARCHIBALD W. ROACH, North Texas State College, Denton.

* Coulter, J. M. and A. Nelson, New Manual of Botany, 1937.

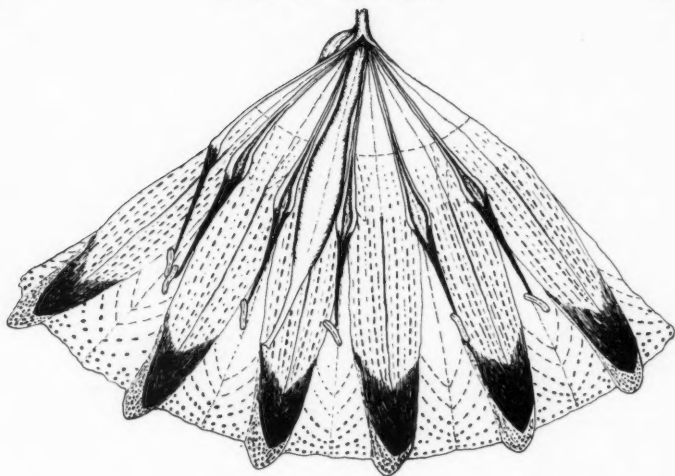


Fig. 1.—An opened flower showing the 6-merous arrangement of the androecium and accessory whorls.

Nembutal as a Relaxing Agent for Mollusks*

With the increasing need for studies of the anatomy and comparative morphology of mollusks, means for relaxing specimens prior to fixation have proven to be of prime importance. In the *Vade-Mecum*, Lee includes a number of agents which have proven useful in narcotization. Among them the more widely known include: menthol, nicotine, chloroform, ether, alcohol, chloretone, chloral hydrate, magnesium chloride or sulphate (Epsom Salts), and others. Often asphyxiation is employed to attain the same end. Among freshwater mollusks menthol has been used with considerable success by E. J. Allen at Plymouth (see Lee, *Vade-Mecum*, p. 10); E. G. Berry (1943); E. Abdel-Malek (1951; thesis, 1952); and others. Although excellent relaxation can be attained with menthol, it has proven often to be too unpredictable. As a consequence, alternate methods are desirable. For example, a colleague who collected aquatic pulmonates in Alaska last summer reported that of the batches of snails prepared for fixation with menthol only, some were satisfactory. His results were summarized in his own words as follows: "Some look pretty good to me and others pretty poor as you will see."

For the past several months our work has been concerned with field and laboratory studies of amnicolid snails in the genus *Pomatiopsis*. As the animals were brought from the field an attempt was made to obtain series of well relaxed specimens. At first menthol was used in this process, but in spite of the fact that the generally accepted technique was employed by two individuals independently there were too many unrelaxed specimens in each batch to warrant the exclusive use of that method. In searching for another anesthetic, nembutal was tested. The idea was first suggested during a field trip with Norman Hartweg who used it to good advantage in relaxing amphibians and reptiles by injection. He told me that it was possible to apply the needle to a rattlesnake while the animal was

* Support for this work was provided in part by the Horace H. Rackham School of Graduate Studies of the University of Michigan.

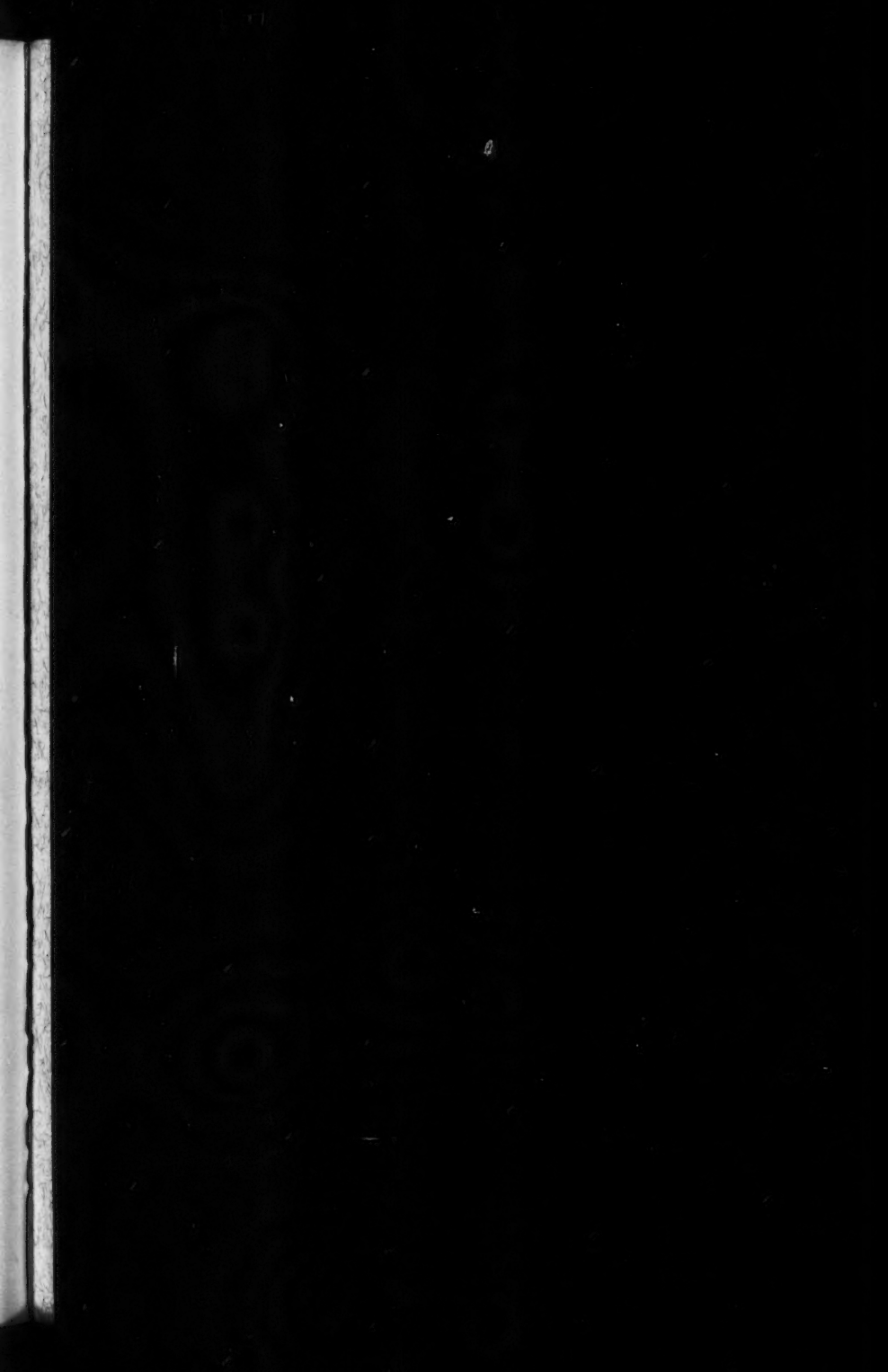
still in the collecting bag. The nembutal worked so well that all danger of handling poisonous reptiles was avoided. During that same field trip the drug was used on aquatic mollusks. The concentrations used at that time were too high, consequently those series did not relax well. Later the nembutal method was suggested to Carl Obrecht of the University of Detroit. He found that by diluting the stock solution to one-tenth good results could be obtained.

In our work with small amnicolid snails of the genus *Pomatiopsis*, the following schedule yielded good results: Fifty to one hundred animals were placed in a finger bowl with about 80 cc of tap water. A few drops of a concentrated alcohol were added to the water. When the animals were quite active, 1 cc of 1/10th stock solution of veterinary sodium nembutal (60 mg. per cc.) was introduced. At intervals of one to two hours the diluted (1/10th) solution was added in doses of 1 to 3 cc. After 12 to 24 hours the animals so treated were well relaxed and ready for fixation. It was of interest to find that there was a constant difference between the two species of *Pomatiopsis* studied. The larger species, *Pomatiopsis lapidaria*, on the average took twice as long in this relaxation process as did the smaller species, *Pomatiopsis cincinnatiensis*. Whether this difference in the time required for complete relaxation is merely a reflection of the difference of size between these forms or whether it is due to a specific difference in reaction to the drug remains an open question.

The addition of a small amount of alcohol prior to the application of the nembutal seemed to irritate or stimulate activity. While they are thus active the drug is applied. It is not clear whether the use of alcohol is advantageous. In these procedures the method is entirely empirical. Information is needed as to how either nembutal or menthol act to bring about the kind of relaxation needed for proper fixation. Lee Worrell of our School of Pharmacy suggested that he could understand why nembutal would serve to relax the animals but in terms of the nature of the substance he felt it would be difficult to appreciate in what manner the menthol caused relaxation. In this connection it is interesting to note that with nembutal one does not have any difficulty due to moving a container or jarring one with snails that are being relaxed. The specimens can even be manipulated without causing contraction. It is generally conceded that, with menthol, it is ruinous to good relaxation to disturb in any way the animals being relaxed.—HENRY VAN DER SCHALIE, University of Michigan, Museum of Zoology, Ann Arbor.

REFERENCES

- ABDEL-MALEK, EMILE 1951—Menthol relaxation of helminths before fixation. *J. Parasit.* 37:321.
———1952—Morphology, Bionomics and host-parasite relations of Planorbidae (Mollusca: Pulmonata) Thesis, University of Michigan—Microfilm Service.
BERRY, E. G. 1943—The Amnicolidae of Michigan; distribution, ecology, and taxonomy. *Mus. Zool., Univ. Mich. Misc. Pap. No. 57.*
LEE, BOLLES (edited by J. B. Gatenby and T. S. Painter) 1937—The Microtomist's Vade-Mecum. Tenth Edition, P. Blakiston's Son & Co., Inc., Phila.



PUBLICATIONS

ARNETT, Ross, H. Jr.—A Revision of the Nearctic Dedemeridae (Coleoptera)	1.00
BAILEY, V.—Cave Life of Kentucky	1.25
BUECHNER, H. K.—Life History, Ecology, and Range Use of the Pronghorn Antelope in Trans-Pecos Texas	1.00
CARPENTER, M. M.—Bibliography of Biographies of Entomologists	1.00
CHERMOK, Ralph L.—A Generic Revision of the Limenitini of the World .....	.50
COLE, A. C., Jr.—A Guide to the Ants of the Great Smoky Mountains National Park, Tennessee .....	.75
COOKE, W. B.—The Flora of Mount Shasta (and supplement)	1.00
FENDER, Kenneth M.—The Malthini of No. America (Coleoptera-Cantharidae)	1.00
FISHER, Harvey I.—Adaptations and Comparative Anatomy of the Locomotor Apparatus of New World Vultures .....	.75
FITCH, Henry S.—Ecology of the California Ground Squirrel on Grazing Lands .....	.75
—Study of Snake Populations in Central California .....	.75
GOODRICH, C. & Henry van der Schalie—A Revision of the Mollusca of Indiana .....	.75
GREENE, E. L.—Manual of the Botany of the Region of San Francisco Bay, Cloth-bound	2.00
Unbound	1.50
—Flora Franciscana (Pt. 2 only) .....	.75
—Plantae Bakerianae	1.30
MCGREGOR, E. A.—Mites of the Family Tetranychidae	1.25
MANTER, Harold W.—The Digenetic Trematodes of Marine Fishes of Tortugas, Florida .....	.75
MILLIRON, H. E.—Taxonomic & Biological Investigations in the Genus Megastigmus with Particular Reference to the Taxonomy of the Nearctic Species	1.00
MURLEY, Margaret R.—Seeds of the Cruciferae of Northeastern No. America	1.00
ORTON, Grace L.—Key to the Genera of Tadpoles in the U.S. and Canada .....	.25
POHL, Richard W.—A Taxonomic Study of the Grasses of Pennsylvania	1.00
RAFINESQUE, C. S.—Neogenyton .....	.25
—The Natural Family of Carexides .....	.50
—Scadiography of 100 Genera of Umbelliferous Plants, etc.	1.50
REED, Chas. A.—Locomotion and Appendicular Anatomy in Three Soricoid Insectivores	1.00
ROTH, Louis M.—A Study of Mosquito Behavior. An Experimental Laboratory Study of the Sexual Behavior of <i>Aedes aegypti</i> (Linnaeus) .....	.75
—A Study of Cockroach Behavior .....	.75
SEALANDER, John A., Jr.—Survival of <i>Peromyscus</i> in Relation to Environmental Temperature and Acclimation at High and Low Temperatures .....	.50
SCHEFFER & Sipp—The Whales & Dolphins of Washington State with a Key to the Cetaceans of the West Coast of No. America	1.00
SCHUSTER, R. M.—The Ecology and Distribution of Hepaticae in Central and Western New York, cloth-bound	2.50
—Notes on Nearctic Hepaticae III. A Conspectus of the Family Lophoziaaceae with a Revision of the Genera and Subgenera	1.00
—Boreal Hepaticae. A Manual of the Liverworts of Minnesota and Adjacent Regions	4.00
SETTY, L. R. & K. W. Cooper—Studies in the Mecoptera	1.00
SINGER, Rolf—The Boletioideae of Fla. (The Boletineae of Fla. with notes on Extralimital Species III)	1.00
STEWART, R. E. et al—Seasonal Distribution of Bird Populations at the Patuxent Research Refuge	1.00
VARIOUS AUTHORS—Plant and Animal Communities	2.50
—Symposium on Paleobotanical Taxonomy	1.00

THE AMERICAN MIDLAND NATURALIST

Monograph Series

- No. 1. *The Argasidae of North America, Central America, and Cuba.*
By R. A. Cooley and Glen M. Kohls. 1944. Cloth, \$2.00.
- No. 3. *The Mosquitoes of the Southern United States East of Oklahoma and Texas*
By Stanley J. Carpenter, Woodrow M. Middlekauff and Roy W. Chamberlain. 1946. Cloth, \$4.00.
- No. 4. *Woody Plants of the Western National Parks.*
By Virginia Long Bailey and Harold Edwards Bailey, 1949.
Cloth. \$4.00.
- No. 5. *Flora of Illinois.*
By George Neville Jones. 1950. Cloth. \$4.25.
- No. 6. *A Manual of the Mosses of Western Pennsylvania and Adjacent Regions. Second Edition.*
By O. E. Jennings. 1951. Cloth. \$4.25.
-

BOREAL HEPATICAE A MANUAL OF THE LIVERWORTS OF MINNESOTA AND ADJACENT REGIONS

by

Rudolf M. Schuster

Pp. vi+428, 110 plates

Paperbound, postpaid \$4.00

The University Press, Notre Dame, Indiana, March, 1953

Address orders to: Publications Office
University of Notre Dame
Notre Dame, Indiana

